THE
REPERTORY
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ARTS, MANUFACTURES,
AND
AGRICULTURE.

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Specification of the Patent granted to GEORGE BEAUMONT, *of South Cross Land, near Huddesfield, in the County of York, and* WALTER BEAUMONT, *of the same Place, Manufacturers of Woollen Goods; for a Mixture to be used in the Preparation of Sheep or Lambs' Wool for various Purposes.* Dated May 17, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said George and Walter Beaumont do hereby declare, that our said invention is described in manner following; that is to say: Our mixture consists of oil united with or diffused in water, by means of an alkaline substance, namely, potash, or pearlash, or soda, or the volatile alkali called ammonia, but we give a decided preference to potash or pearlash. The proportions and manner of making the said mixture are the following: Dissolve the best potash alkali in the water, in the quantity of about twelve ounces of alkali, in each gallon of

 water;

water; and, when the solution is completed, two measures of the same, or thereabout, are to be added to one measure of the oil, and united by stirring or agitation; and the three measures of compound liquor, thus produced, do constitute and form our said mixture, and will be found to produce the effect of oil when applied in the same manner as oil is commonly used in manufacturing cloths, coatings, kerseymeres, blankets, and every other description of woollen goods.

No instructions are necessary to be given with regard to the oils, or the method of applying the mixture, or the quantity of the same to be used with wools of various qualities and colours, because the oils may be of any kinds suitable to be used with wool, and the operations must be governed by the usual skill and judgment of the workman.

Now farther, we do hereby state and declare, that although the description here given is a true and full specification of the practice or method of making and using our said mixture, we do nevertheless apprehend, that it may be of some advantage to the public to state our notions with regard to the nature of the said mixture, as far as concerns the effect thereof, *viz.* In all the operations upon wool, the manufacturer endeavours either, first, to extend it by carding or spinning, or similar practices; or, secondly, to unite, condense, and connect the same by weaving, fulling, felting, and the like. In the first of these two distinct purposes it is necessary that the fibres of the wool should, by means of some lubricating matter, be made to slide easily over each other, instead of fixing, knotting, and entangling themselves together, and no material hath been heretofore known which was adequate to the effect, except oil in a pure state, or nearly so. Water itself is too harsh a fluid, and soon evaporates;

evaporates; and the perfect combination of oil and alkali called soap (if dissolved in water in the large proportions requisite) is found to become stiff, and cloggs the staple or fibres of the wool. But our mixture being in fact a diluted solution of the best potash, or alkali of commerce, not in the caustic or chemically pure state (though in this degree of dilution the caustic alkali may be used in forming our said mixture), but naturally combined in part with carbonic acid; and this solution being mixed, by agitation, with a large proportion of oil, the result must consist of oil, minutely divided, slightly alkalized, and capable of being applied over the extensive surface of the fibres, together with a solution of mild or partly saturated alkali, which it is well known does not become perfectly dry, but is disposed to remain in the state of deliquescence. This last fluid is (as we apprehend from the facts) well adapted to assist in the lubrication along with the oil, and even to produce an effect, by their joint action, superior to that which either fluid singly could have done.

In witness whereof, &c.

Remarks.

To the superiority which this mixture possesses over oil, as pointed out in the above specification, we have to add, that in the operation of scowering or cleaning the goods from the oil after they are wove, less time and labour is required. It is proper to observe, that in no instance is the effect of this composition, when applied to the wool, different from oil, except on very greasy or salvy wool, and on which we do not recommend its use (particularly in hot weather), unless such wool has been previously scowered.

Specification of the Patent granted to Antonius Bemetzrieder, *of Chelsea, in the County of Middlesex, M. A.* Robert Scott, John Scott, *and* Alexander Scott, *all of Margaret-street, Cavendish-square, in the said County, Musical Instrument-makers; for making Piano Fortes, entirely new both in Principle, Construction, and Shape.* Dated November 10, 1801.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, we the said Antonius Bemetzrieder, Robert Scott, John Scott, and Alexander Scott, do describe and ascertain the nature of our said invention, and in what manner the same is to be made and performed, as follows; that is to say:

First. The strings are fixed upon a frame, which has the shape of an irregular hexagon, in a way or method similar to, and imitating, as nearly as possible, the office of an horizontal harp. This string-frame is strong enough in itself to resist fully the drawing of all strings used either in grand or square piano fortes; and although the front and right sides of the frame are apparently connected with the exterior circumference, yet they require no additional strength from it, or from the bottom, to resist their respective drawing forces.

Secondly. The belly, with its two respective bridges, is fixed within the string-frame at the upper or widest part thereof, but an additional bridge can be added, dividing the compass of strings into three equal parts, and may be placed on the same belly, or on a separate small belly, at the lower or narrow extremity of the string-frame.

Thirdly.

Thirdly. The width of the string-frame is determined by the extention and compass of strings contained and placed on its respective bridges, *viz.* three unison strings to each note want eighteen inches for the largest width, and fourteen inches are sufficient for two unison strings to each note of an additional key'd instrument of sixty-eight keys.

Fourthly. The exterior circumference or outward case of the instrument is rectangular, the front-side circular, and the back, right and left sides straight; but, this circumference could be oval or triangular if so desired or required. The length and width are comparatively smaller than any one possible upon the old construction.

Fifthly. The front and back of the instrument have both doors in the middle near the string-frame. From the front doors the keys are drawn out for the player; and from the door in the back all the parts of the action can be regulated or mended when required.

Sixthly. The frame of the action is unconnected with the string-frame. Each frame is independent of the other.

Seventhly. Besides the ordinary motions up and down, the keys have an horizontal motion from the back to the front, and *vice versâ* from the front to the back.

Eighthly. The dampers are above the strings, but may also be under them. When above the strings they may be taken out one by one, being loosely suspended on the strings in an upper and under socket, which sockets are fixed to the front side of the string frame in an horizontal position. When under the strings, they draw out at the back-opening, in both cases their lifters are independent of the keys.

Ninthly.

Ninthly. The top of the instrument opens at the back by means of a swelling pedal; and at its front is a musick desk, which rises out of the top itself equi-distant from the extremities of the keys. This desk is first separated from the top, and afterwards affixed to the opening, made by such separation, by means of two small hinges, thus capable of being elevated to any degree of inclination the player may choose, being supported when elevated by a moveable back foot, which, together with the whole desk, shuts down within the limits of the said opening. The whole top is made to be taken off with the greatest ease, by unfastening the turn buckles or strong brass hooks which fasten it at its two ends or greatest extremities.

These differences from the old construction are not merely works of chance, they are grounded on principles either hitherto unknown or neglected.

First. Besides the known proportions, there is a maximum, that is, a more advantageous point where the hammer ought to strike the string. This maximum requires the action in the middle of the instrument.

Secondly. Strings riding upon a sonorous plank can give but a thin and stiff tone; but strings riding upon a sonorous body must give a finer, full, and singing tone. This is the reason that the new string-frame has all the solidity wanted to resist fully, and by itself, all the drawing forces, in order that a light and sounding back may form a sonorous body with the bridge-belly.

Thirdly. The piano forte music is harmony; and harmony proceeds in its propagation from the treble to the bass, and ought to go directly, and without reflection, from the action of the player to the ears of the auditors. This is the reason why these new instruments have the bass and swelling at their back.

Fourthly.

Fourthly. The piano forte takes its name from its particular movement, which must be simple, free, and elastic, in order that the player has under his fingers the piano's, fortes, more piano's, more fortes, pianissimo's, fortissimo's. This is the reason that all the parts of the instrument are independent one from another; and the whole so constructed as to obey the player who has taste and swelling at the end of his fingers.

In witness whereof, &c.

Specification of the Patent granted to John Norton, *of Rolls-buildings, Fetter-lane, Fleet-street, in the City of London, Mathematical Instrument-maker; for an Improvement in the Construction of a Water-Mill.*

Dated July 28, 1803.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John Norton do hereby declare that my said improvements in the construction of a water-mill are described in manner following; that is to say: I apply a screw, either horizontally, vertically, or obliquely, to the impulse of the water, and in such a way that the screw may receive a motion from the water round its own axis; and being applied to, and connected with, any of the well-known machinery used in mill-work, shall produce and communicate to such said machinery such motion and effects as may produce the general purposes of a water-mill. I make the screw of wood, iron, copper, or any other material, the circumstance of size, place, &c.

&c. may require, and either with single or double threads, and with one, two, or more threads, and deeper or less deep in the thread, as the said circumstance may require. The general appearance of a screw of this kind, and the method of applying it to other mill-work machinery, is shewn in Fig. 1, in the subjoined drawing.

A, Fig. 1, (see Plate XIII.) represents the screw with its axis. B, B, bevel-wheels, one of which is fixed on the axis of the screw, and the other on an axis which stands at right angles to it, and carries other mill-work machinery, &c. M M M M, is a vertical section of a rectangular or other conveniently-shaped vessel, open more or less to admit the access of the stream to the screw A. G G, a punt, barge, or other floating vessel, to which the machinery is fixed.

Fig. 2, represents the geometrical horizontal view of the vessel M M M M, shewing the method used to support the axis of the screw by iron or other bars *b*, *b*, bolted or otherwise fastened to the sides of the vessels at *c c*. In the centre of each bar is a plate *a*, on which is fixed a block or other stay, in which the axis of the screw is held in its required position.

Fig. 3, is an end geometrical view of the vessel M M M M, shewing in *b a b* the elevation of the bars *b*, in Fig. 2, and the block which holds the axis of the screw.

Fig. 4, represents in *a a* the axis of the screw being made of wood, iron, or any other material which may be relatively suitable to the intended size of the screw. It is made in one, two, or more lengths, and is joined by couplings, as at *d*, in the drawing, or otherwise.

In witness whereof, &c.

OBSER-

Fig. 1.

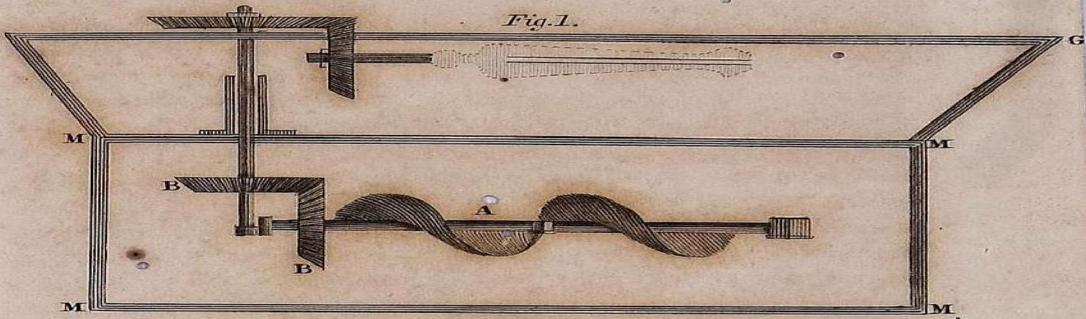


Fig. 2.

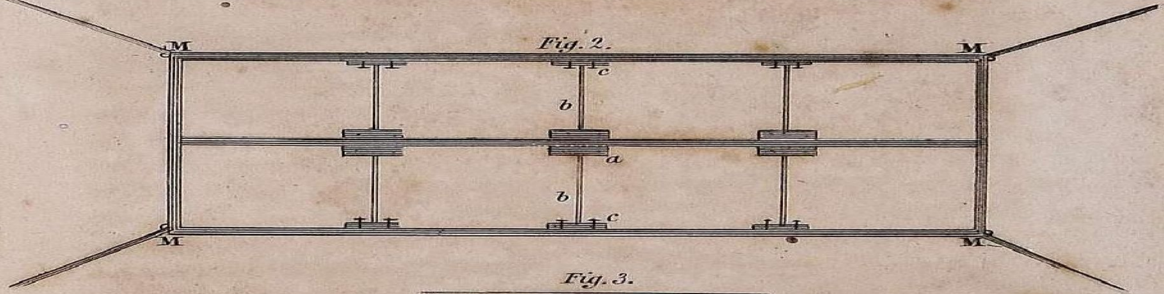


Fig. 3.

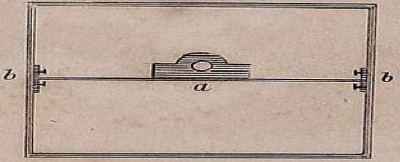


Fig. 4.

Observations by the Patentee.

The great object of this invention is to acquire more power from the impulse of the water than can be obtained by the common water-wheel, which does not receive the stream on above one-third of its circumference; and meeting with a considerable opposition from the surface in going down, and having a considerable weight of water to lift in rising, must subtract considerably from its power. But the screw moves freely with the stream, which it receives on its whole circumference at once, and meets with no opposition to lessen its power, which must therefore be at least three times that of the wheel.

Again: The wheel takes the stream near the surface; the screw takes the bottom of the stream, which is heavier and stronger, and, working under the vessel that carries the mill-work, is not liable to be damaged.

The above is applicable to any purpose that may require a moving power. Grinding of corn, boring cannon, &c.

Specification of the Patent granted to Thomas Fulcher, *the Elder, of Ipswich, in the County of Suffolk, Surveyor and Builder; for a Water-proof Composition, in Imitation of Portland Stone, for stuccoing and washing new and old Stone and brick Buildings, and for cementing the Joints, and tucking and pointing all Stone and Brick Works that require Proof against Water.*

Dated May 27, 1803.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Thomas Fulcher do hereby declare that my

my said invention of a water-proof composition, in imitation of Portland stone, consists in preparing and compounding the same in the following manner, *viz.* To three pecks of the best pit-sand, washed till perfectly cleansed from soil or dirt, dried and calcined, add twelve pounds of white-lead, well dried; one peck and a half of dried whiting and one pound of lithrage of gold. These are to be well mixed and beaten together with eight pints of linseed-oil and two pints of the spirits of turpentine, in a stone or wooden trough or mortar, till the whole becomes about the consistency of common putty. It is then fit for stuccoing. When required for washing only, then add to the above mixture twenty pints of linseed-oil and ten of the spirits of turpentine and one pound of litharge of gold, the whole well mixed. Although these proportions are given as those which will be found best for general purposes, yet they may be varied according to the discretion and judgment of the workman. The stuccoing is to be performed in the same manner as plastering, and requires two coats, observing however not to lay on the second coat till the first is quite dry. Old walls must be prepared by cutting out the bad parts of the stone or brick, and replaced with new. The washing is done in the manner of painting, and requires two coats, the second colouring not to be laid on till the first is perfectly dry. This stucco and wash have the properties of keeping out all damps and wet effectually.

In witness whereof, &c.

A Description

A Description of the Pendant Planetarium. *Invented by* Burgiss Allison.

With a Plate.

From the Transactions of the American Philosophical Society.

Fig. 1, *a a a a*, is a frame, supporting the whole machine. *b b*, is a fixed rod or arbor supporting the segment *c*, and the sun S by a fine wire. *d*, is a wheel, fixed to the upper part of the cannon *e*, carrying round by its lower end the arm *f f*, and the planet Mercury suspended by a fine dark wire. *g g*, is an arm, fixed by screws into the frame *a a* at each end, and also to the upper end of the fixed cannon *h h*, which supports by its lower end the frame *i i*, which, as explained in Fig. 2, is an elliptic plane, supporting, by four or more studs *l l*, the concave piece *k k*, forming an elliptic ring. *m*, is a wheel on the moveable cannon *n n*, which carries the arm *o o*, supporting on one end the planet Venus by a fine wire, as above. *p p*, as before, is a fixed frame attached to the immoveable cannon *q* and the elliptic plane *r r*, supporting by studs the concave rings *s*, *s*, *ut supra*; and thus the wires, by which the planets are suspended, and the concave rings are alternately supported by the moveable and fixed cannons, &c. until the whole forms a concave like the heavens; having the small grooves or apertures through which the planets supporters move round, forming elliptic lines in the concave segment of a sphere, marking out the planets paths, according to their eccentricity, and shewing at one view the places of aphelion, perihelion, &c. of all the planets. The concave

 silver

silver stars, in the position that some of the fixed stars would appear from the centre of the sun, will have a fine effect, especially as the supporting wires of the planets will be dark, and so small as to render them almost invisible, the frame being suspended from the ceiling. Their latitude may readily be ascertained by a line drawn from the centre of the sun through that of the planets place to the hoop *t t*, encompassing the whole, marked with eight degrees on each side of the ecliptic. The elliptic orbits and inclined planes are obtained by the method shewn in Fig. 2, *viz.*

a a, is an elliptic plane, fastened to the lower end of each fixed cannon, having its eccentricity calculated to that of the planet which is to be affected by it. *b b*, is the arm attached to the moveable cannon. *c c*, is a slider moving on the arm *b b* by four little friction rollers. *d*, is a friction wheel on the under side of *c*, turning on a pin, which is fastened firm on *c*, and moves with it through a groove in *b b*, which wheel, running against the edge of the ellipsis *a a*, forces *c c* out, which is again drawn in by the spring *e*, thus causing the planet to revolve in an elliptic orbit, as it is carried round by the arm *b b*, the moveable cannon, and wheel-work.

For the inclined plane, *g* is a wheel turning on a pin fastened into *c c*, and carried round on it by a projecting arm of *b* *. On one side of this wheel is a small pin, whose situation and distance from the centre is to be determined by the place of the planet's nodes, and the inclination of its plane to that of the ecliptic; to this pin is fastened a small waxed silk cord, which, passing

* The circumference of the wheel must be commensurate with the distance *c c* moves out.

over

over the pulley *h*, supports the planet by a fine hair wire, as before described, and draws it up and lowers it down in its orbit according to its angle of inclination to the plane of the ecliptic. The planets should be made of polished metal, to give them weight and brilliancy, or of small glass globes filled with mercury. The sun may be a globular glass fountain-lamp, with a cork fitted to the tube, containing a tin pipe for the wick, so that the blaze being in the centre of the globe, and surrounded with oil, will be magnified on every side, and exhibit a splendid sun. It will be readily understood that motion is to be given to the wheels, turning the cannons, &c. by an arbor having as many wheels as the planets have, all firmly fixed to the arbor, and calculated to move them in their proper periods. The whole may be made of wood, if required, and the wheels turned by elastic wire bands. To the machinery may be attached a simple movement, whose weight may descend down the wainscot of the room in any convenient place. Thus the planets will be seen moving round the sun in the concave above, in elliptic orbits and inclined planes, apparently revolving in the heavens without any support.

It is easy to conceive how the same principle, as far as it respects the eccentricity and angles of inclination, may be applied to either vertical or horizontal orreries; by having the wires which support the planets sufficiently stout to bear their weight either in a perpendicular or horizontal position, and sliding in and out of small tubes as they pass round in the elliptic grooves on the face of the orrery. They may be drawn in by the wheel-pin and cord, as described in Fig. 2, and forced out by small springs. In this case their latitude may be marked on

on the supporting wire, and the top of the tube in which they slide will serve as an index. Or the degrees may be marked on the edge of a groove cut in the tube, through which an index, fastened to the moving wire or stem which supports the planets, may pass; and thus give the latitude.

Appendix to Mr. WILLIAM HENRY's *Paper on the Quantity of Gases absorbed by Water at different Temperatures, and under different Pressures* *.

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

SINCE my paper was printed, I have found that the numbers assigned in it, as indicating the quantities taken up by water, of some of the more absorbable, and of all the less absorbable gases, are rather below the truth. The accuracy of these numbers I was led to doubt, by a suspicion that due attention had not always been paid, in my former experiments, to the quality of the unabsorbed residuum. For the theory which Mr. Dalton has suggested to me on this subject, and which appears to be confirmed by my experiments, is, that the absorption of gases by water is purely a mechanical effect, and that its amount is exactly proportional to the density of the gas, considered abstractedly from any other gas with which it may accidentally be mixed. Conformably to this theory, if the residuary gas contains $\frac{1}{2}$, $\frac{1}{10}$, or any other proportion of foreign gas, the quantity absorbed by water will

* See the last Number of this work, page 255.

be

be $\frac{1}{2}$, $\frac{1}{10}$, &c. short of the maximum. The proof of these propositions would lead me into a minuteness of detail, not suited to the present occasion; I therefore hasten to communicate the results of my latest experiments.

The report which I have already given, of the quantity of carbonic acid gas, absorbed under the ordinary pressure of the atmosphere, I find no reason to correct; but, of sulphuretted hydrogen gas, I have effected a larger absorption than the one before stated; and have repeatedly observed its amount to be 106 or 108 by 100 measures of water, at 60° of Fahrenheit, which temperature is to be understood in all the following experiments.

Of several experiments on the absorption of nitrous oxide, I take the following, as a fair example of the whole. I agitated, at three several times, 1175 measures of nitrous oxide, with 1320 measures of water; 1025 parts of gas disappeared, and the unabsorbed remainder (150) contained 15 of foreign admixtures. It follows, that 100 parts of water had taken up 77.6 of nitrous oxide; and, after adding to these the diminution of absorption occasioned by the impurity of the residuum, it may be inferred, that 100 parts of water would absorb 86 of absolutely pure nitrous oxide.

With respect to the remaining gases, I have been prevented, by urgent professional engagements, from examining the quantity of each, absorbable under similar circumstances, except in the instances of oxygenous, azotic, and hydrogenous gases. The results of these experiments are comprised in the following table. The first column shows the quantity of gas which 100 parts of water, at 60°, have actually absorbed; the second, the quantity which ought to be taken up, provided the residue were in a state of absolute purity. In the example of

of nitrous gas alone, the estimated is less than the actual absorption; because a small portion of this gas loses its aërial form, by union with the oxygenous gas, from which water cannot be entirely freed.

Table shewing the Quantity of each Gas absorbed by 100 Measures of Water, at 60°.

	Actual Absorption.	Inferred Absorption.
Nitrous gas	5	5
Oxygenous gas	3.55	3.7
Phosphuretted hydrogen gas	2.14	
Gaseous oxide of carbon	2.01	
Carburetted hydrogen gas	1.40	
Azotic gas	1.47	1.53
Hydrogenous gas	1.53	1.61

Hints as to the Advantages of old Pastures, and on the Conversion of Grass Land into Tillage.

From Essays on Miscellaneous Subjects.
By Sir John Sinclair, Bart.

HAVING corresponded with some intelligent proprietors, and practical farmers, on the important question recommended by the Board of Agriculture to the attention of the public, namely, "*The Propriety of converting* "*Pasture Land into Tillage*," I have thought it a duty incumbent upon me, as a Member of the Board, and a well-wisher to the improvement of the country, to communicate the result of that correspondence, as several of the observations transmitted to me on that subject seemed to be of considerable importance.

I. *Advantages*

Fig. 1.

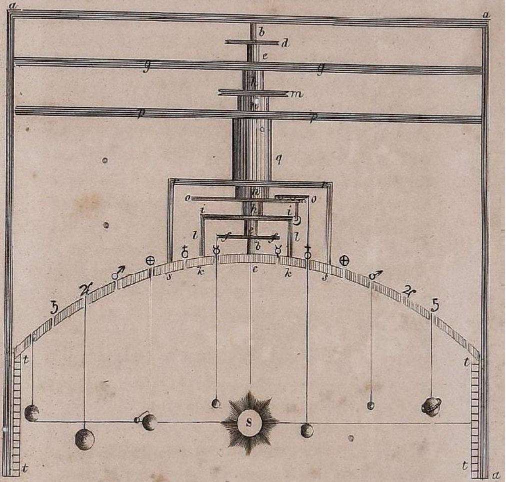
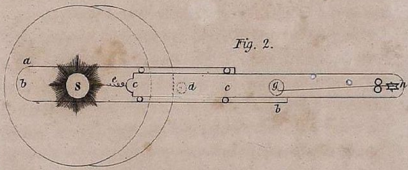


Fig. 2.



I. *Advantages of old Pastures.*

Before, however, the propriety of ploughing up old pastures is discussed, it may be proper, in the first place, to point out some of the most important advantages to be derived from them.

1. The first advantage contended for is, that old pastures answer better for making butter and cheese than artificial grasses, and the idea is probably well founded. All seeds, particularly clovers, give the milk a strong taste, and although the quantity may be as great, or even greater, yet the quality is always worse; it will cast up less cream in proportion, the butter is less firm and waxy, and it will not keep so well. The cheese also is considerably inferior.

2. It is next asserted, that old pastures are better calculated for feeding cattle and sheep; but this can only be admitted with certain qualifications. In the opinion of that respectable farmer, Mr. Culley, (who has had fifty years experience in the grazing line,) "Artificial "grasses, suited to the different soils, will be found to "answer better than old grass, for feeding cattle, ewes, "and lambs, during the beginning, and for the greater "part of the summer; and even during the autumn, ar-"tificial grasses will feed ewes and lambs better than old "grass; whereas, on the other hand, fogs (or after-maths, "as they are called in the southern parts of England) from "old grass, will certainly feed cattle better in the au-"tumn, the richness, luxuriance, and strength of such "herbage, being better calculated for their constitu-"tions." It is believed, indeed, that it is hardly possible to fatten a large ox, to any degree of perfection, on herbage alone, without such pastures.

3. It is farther contended, that the hay made from old grass, though not so bulky, yet is of a better quality, and will keep longer in a good condition than hay made from artificial grasses, particularly from a mixture of clover and rye-grass.

II. *Description of the Lands that ought to be kept perpetually in Grass.*

As old pastures are attended with such peculiar advantages, it is desirable to know, what description of land ought to be kept perpetually in grass. It is certain that there are many old grazing pastures, which can afford to pay a considerable permanent rent in grass, even at a distance from any populous town, the value of which might be reduced if subjected to the plough. It is the opinion of Mr. Culley, that soft heavy loams, with a clayey or marly bottom or substratum, are universally injured by ploughing. Water-meadows also should never be ploughed, as they furnish so large and valuable a produce in spring, in summer, and in autumn, without any other help than water, whilst the manure made from that produce goes to enrich the rest of the farm.

With these exceptions, and that of land apt to be overflowed, there is every reason to believe, that old pastures may occasionally be converted, with public advantage and private benefit, into arable land.

III. *Obstacles to the Conversion of old Pastures into Tillage.*

Before, however, the conversion of old pastures into tillage is recommended, it is right to consider, what are the obstacles which may stand in the way of such conversion; for, unless they are removed, any recommendation to that effect would be useless. These obstacles

stacles are, 1, Tithes; and, 2, The restrictions of the landlord.

In regard to tithes, whilst they continue undefined, they operate, in a peculiar manner, against the conversion of old grass lands into tillage, by depriving both the landlord and tenant of so large a proportion of the profit to be derived from it; and as there is every reason to believe, that a very considerable extent of land in England is kept perpetually in grass, in order to avoid the payment of tithes in kind, is it not a most unfortunate circumstance, that some means are not thought of for commuting, on equitable terms, a right that operates injuriously to the agricultural interests of the country?

As to the restrictions of the landlord, they are often necessary for the protection of his property. But, in the course of the inquiry, it will probably be in the power of the Board to point out the conditions under which old pastures may be ploughed up, not only without detriment, but with advantage to the landlord, and to the public.

IV. *Preparation of the Soil.*

The preparation for the tillage crops may be considered under three heads: 1, Draining; 2, Paring and burning; and, 3, Manuring.

In regard to *draining*, it should be done effectually before the land is attempted to be ploughed; for very possibly it may have been kept in pasture on account of its wetness.

As to *paring and burning*, it is certainly a useful practice where old grass lands are broken up, for it destroys numberless eggs and larvæ of insects, which are extremely injurious to the succeeding crops, and it almost

 insures

insures the tenant from any damage he is otherwise likely to sustain from wire-worms, grubs, &c. Indeed where the land is rough, with furze bushes, brambles, ant-hills, strong heath, &c. it is hardly to be dispensed with. If the land is so smooth and friable that paring and burning is not necessary, the best plan to adopt is, *to double plough it*, by means of two ploughs following each other, the first plough taking off a thin surface of about three inches, and the second going deeper in the same place; both furrows not to exceed six inches. Mr. Ducket's skim coulter does the work at one operation. This plan is certainly the best to pursue where paring and burning, from prejudice or any other circumstance, will not be permitted.

As to *manuring*, if the land is not to be pared and burnt, lime might be spread on the surface, some time before ploughing, in order to destroy grubs and insects; but old pasture lands are in general rich enough to be abundantly productive, without dung, until they are about to be laid down into permanent pasture.

V. *Course of Crops.*

The rotation of crops must depend upon the nature of the soil, and the manner in which it is prepared for cultivation.

If the land is pared and burnt early in the season, turnips is the best article that can be sown; and it is found by experience, that turnips thus raised will go farther in feeding cattle or sheep than any other. If it is late in the season before the land is burnt, cole or cabbage may be adopted: if the land is broken up without being pared or burned, early oats will be found the most profitable crop, being so extremely productive on all fresh clean ground. Mr. Culley states, that there are various sorts

of

of early oats, suited for the different soils: for instance, on rich leys of strong loam, Polish oats ought to be preferred, of which that sort called Church's oats, is by far the best variety. On lighter soils, the Dutch, or Friezeland oat has been found to answer best: but, on the whole, on loamy soils, no species has been found comparable to the potatoe oat, so called from its having been accidentally found in a field of potatoes, in one of the northern counties. In regard to the succeeding course, on dry soils, turnips, potatoes, and clover, ought to be the prevailing green crops; on mixed soils, beans may be added; and when the mixture inclines to heaviness, cabbages. The following rotation is particularly recommended, on a lightish soil, by Sir Alexander Ramsay; namely, 1, Oats; 2, Turnips, with dung and lime; 3, Barley, with seeds; 4, Clover; 5, Wheat; 6, Turnips; 7, Barley and grass seeds; and then to remain in pasture. This intelligent and respectable farmer is decidedly of opinion, that a complete rotation of seven years is to be preferred to any shorter term. The farmer is thus enabled to profit by his labour, and thoroughly to pulverize and reduce the soil. It may then be laid down in a husbandman-like manner, enriched, and not exhausted, and likely to produce both hay and pasture in abundance and perfection.

VI. *Management during the Rotation.*

When land of a light quality is laid down with turnips, sheep should be folded on them. If the land is strong, or wet, the green crops grown thereon ought to be drawn, and fed in some adjoining grass field, or in sheds. If the land is in very high health and condition, some farmers would be inclined to cart off half the turnips, and

to

to eat the rest on the ground, though this is not a plan to be universally recommended.

In regard to manuring, it may be proper to observe, that the dung and lime ought to be applied to the turnips, or other green crop, but never to the different sorts of grain.

VII. *Mode of laying down to Grass.*

Grass seeds in general should be sown with the barley, or the crop succeeding turnips, or any other green crop that may be preferred: *the quantity* of grass seeds must be governed by the state and quality of the soil. Old tillage land requires, in addition to the clover, three pecks, or one bushel of rye-grass seed *per* acre; whereas new-ploughed lands may do with half that quantity, or even less. Heavy lands, if they are to be broken up again in one or two years, require from 10 lbs. to even 20 lbs. of red clover, besides a bushel of the best or Pacey rye-grass; for the seeds are very apt to miss on such soils, except in very favourable growing seasons: but if such lands are to remain in grass, from 4 lbs. to 6 lbs. of marle-grass or perennial red clover, and 4 lbs. to 5 lbs. of white, with as much yellow or hop clover, and a bushel of the best rye-grass, will be necessary. If any doubt is entertained regarding the marle-grass, from 4 lbs. or 5 lbs. of common red clover may be used in its stead. All dry soils may have from 2lbs. to 4lbs. of hop or yellow clover seed *per* acre, in addition to the white clover seed, and the perennial red clover, or marle-grass already mentioned. The following plan is recommended by Mr. Bridge (a respectable farmer in Dorsetshire) for laying down land for permament pasture; namely, to sow from 6 lbs. to 7 lbs. of white clover; ditto, either of marle-grass or of common red clover; ditto, of hop clover; and one

one bushel of the best Devonshire rye-grass, which resembles much the Pacey rye-grass. By this means, there is a perpetual feed for five or six years. The hop, clover, and rye grass flourish early in the spring; the marle-grass is in perfection in July, when the other goes off; and the white clover is in perfection in August, and continues during the remainder of the season. In some meadows of very rich soil, perhaps lucerne ought to be preferred, and it would be of infinite importance to have it ascertained, to what extent that culture could be carried.

As to providing the seed, much must depend upon the character of the tenant, who may often be intrusted with that charge; but if he is too fond of the plough, it is the safest plan for the landlord to provide the seeds, as it must be for his interest to procure the best that can be purchased, to prevent any necessity, from the unproductive sate of the grass, to have again recourse to tillage.

VIII. *Increase of Rent.*

It is evident that any tenant would be willing and able to give an increase of rent for the liberty of ploughing up old pastures. What the addition ought to be, must be governed by the situation, the quality of the land, the price of grain, and other circumstances. In Scotland, double rent and upwards is not unusual on a lease of four years. The Earl of Rosebery lately let about 300 Scotch acres of old pasture at that rate, some part of which produce 8 *l. per annum* *. It had been pastured, however, for more than sixteen years, and was situated within eight miles of Edinburgh. The high rent, pay-

* Equal to 6 *l.* 8 *s. per* English acre. In many instances old pasture land would fetch in Scotland from 8 *l.* to even 10 *l. per* English acre.

able

able for such lands in Scotland, may be attributed to the following circumstances:

1. That land fit for tillage is less abundant in the northern part of the island than in England. 2. That old pastures are peculiarly well calculated for producing oats, the general food of the people *. 3. That such lands are in general so rich as to require but little manure, consequently the manure arising from the crops they produce may, in a great measure, be devoted to the improvement of the rest of the farm. 4. That the tenants in Scotland are not subjected to the payment of tithes, nor of poor-rates, or other taxes. And, lastly, that there is either a greater spirit of speculation among the Scotch farmers, or that they are contented with less profit than the English.

IX. *Conditions under which the Liberty of Ploughing may be granted.*

But the increase of rent is not the only particular that a landlord has to take under his consideration when he grants the liberty of ploughing up old pastures. Unless care is taken, when they are broken up, that it is done under a proper system of management, the execution of which is enforced by the strictest regulations, the real value of the property may be materially injured. The conditions, therefore, that ought to be stipulated by the landlord, is certainly not the least important branch of this inquiry.

In considering the general nature of the conditions that ought to be required, I have derived much benefit from perusing the articles which were obligingly com-

* It appears from the corn tables, that wheat is almost always cheaper in Scotland than in England, and oats the reverse.

municated

municated to me, by the Earl of Rosebery, and, according to which, that noble lord, in January, 1801, let a considerable tract of old pasture land, part of the estate of Dalmeny, in the neighbourhood of Edinburgh.

Art. 1. By this article the fields were to be set up to auction, and the highest bidder was to find security to fulfil the terms he had agreed to.

Art. 2. The grounds were let for four years. First crop, *oats*; second crop, *turnips or other green crop*; if a naked fallow, four ploughings; third crop, *barley and grass seeds*, with two or three ploughings; and, fourth crop, *hay*; prohibiting wheat, hemp, flax, &c. under the penalty of 10 *l. per* acre of additional rent.

Art. 3. The tenant to plough the land properly, to hoe and weed it, &c. to sow with the third crop at least one bushel and a quarter, or one Scotch firlot, of rye-grass, 12 lbs. or 14 lbs. good red clover seed, and 4 lbs. white clover, and sufficiently to harrow, stone, and roll the same, entirely at his own expense.

Art. 4. The tenant to have liberty to cut and carry away the foggage, or second crop of grass, in the fourth, or last year, but not to pasture the same *, and to remove every article belonging to him on or before the 1st of November, 1804.

Art. 5. The tenant to preserve the gates and fences, to keep the ditches, &c. clear and open, and to leave them in good condition at his removal, and, if neglected, the same to be done by the landlord, at the tenant's expense.

Art. 6. The tenant who shall be preferred, to sign a proper deed or instrument, with a sufficient surety, specifying the terms agreed upon.

* This restriction was intended for the preservation of young fences; but, where the fields are completely fencible, Lord Rosebery prefers obliging the tenant to pasture the second crop of clover.

Art. 7. Accommodation given to the tenant to stack and thresh the crop, under certain obligations, that he shall keep the barn and corn-yard in repair.

Art. 8. An arbiter appointed to determine all differences: the expense attending any dispute to be paid by the person against whom judgement shall be given.

Art. 9. Tenants to remove, without the necessity of previous notice, under certain penalties.

Art. 10. Power reserved to the landlord, or to persons he may appoint, to inspect the fields from time to time, also to work coal and lime-stone, and other stones or gravel, to sink or dig pits, to make roads, and to do every thing necessary for carrying on such works, (allowing to the tenant the yearly value of the ground thus taken up, or rendered useless,) also reserving the power of carrying off wood and underwood, paying the damages arising therefrom.

It is evident, that, under such prudent conditions as these, if properly enforced, the most cautious landlord may suffer old pasture lands to be converted into tillage, without any material risk of his property being thereby injured.

X. *On the Propriety of laying down some of the Tillage Land into Grass.*

Wherever circumstances will admit of it, the landlord will find it for his interest to lay down the same quantity of old arable land into pasture that is broken up from pasture and rendered arable, by which change the farm will, on the whole, be much improved, and consequently it is for the advantage of the landlord to consent to the alteration. It is, at the same time, in the opinion of one of our most intelligent farmers, (Sir Alexander Ramsay,) one of the most difficult operations in husbandry, to lay down

down old tillage land that has been for years under a ploughing system, (as under fallow, wheat, beans, &c.) into permanent grass. One rotation will not be sufficient to produce good pasture; it may be found necessary to have two complete rounds of management, different from what the land has been accustomed to; as, 1, turnips, cabbages, or summer fallow. 2. Barley, with 12 lbs. of clover and ½ bushel of rye-grass to each acre. 3 and 4. Clover, to stand two years. 5. The clover to be broke up for drilled beans or peas, according as the land is heavy or light. 6. Turnips, with manure. And, 7, barley, with such grass seeds as are fit for permanet pasture. When the field has gone through these rotations, and in the course of them has been twice manured, it can hardly fail to produce good pasture, more especially if care be taken the first year to feed it off with sheep.

XI. *On the greater Productiveness of Arable compared to Pasture Lands.*

Having thus shortly stated the manner in which old pasture lands may be converted into tillage, it may be proper briefly to explain how much the public is interested in such a conversion, in consequence of the much greater quantity of food for man, that is produced by land in tillage. According to Archdeacon Heslop's comparative statement lately published, the weight of food from an acre of arable, on the average of three years, a fallow year being included, is nine and a half times greater than from an acre of feeding stock; and, according to the calculations of a very intelligent correspondent of the Board, the Reverend Dr. Walker, of Collington, a Scotch acre of land in pasture, fed with sheep, produces only 120 lbs. weight of meat; whereas the same land will yield 1,280 lbs. weight of oatmeal, or above ten

times as much in weight *. This is so important a circumstance, in a public point of view, that it merits particular attention, as it tends to prove, that where one million of people may be maintained by pasturage, several millions may be maintained by tillage, and without any additional extent of ground for working horses, cattle, &c. if the land be cultivated by the spade.

XII. *Conclusion.*

On the whole, though it may not be advisable to recommend the ploughing up of very rich old pastures, or water meadows, or land apt to be overflowed, yet, with these exceptions, there is every reason to believe, that other sorts of grass lands may be rendered much more productive, by being occasionally converted into tillage; and for that purpose it is desirable, that the conversion of such lands should be promoted as much as possible; by removing the obstacles to such conversion;—by enforcing the necessity of commuting tithes, without which no considerable tract of old pasture can be broken up;—by pointing out to landlords the conditions under which they may agree to such a plan, not only without detriment to the real value of their property, but also yielding a most important addition to their income;—and, above all, by explaining to parliament, and to the public, that the measure above recommended is one which may effectually tend to prevent future scarcities; and to render this country independent of foreign nations, in the important article of provisions.

* If cultivated in whole, or in part, with potatoes, the difference would be still greater. At the same time it is to be observed, that grain will not go so far as meat in the maintenance of man. The proportional difference between the two has not yet been ascertained.

On

On the Nourishment of Vegetables.

By A. Hunter, *M. D.*

From Hunter's Georgical Essays.

I LAY it down as a fundamental maxim, that all plants receive their principal nourishment from oily and mucilaginous particles incorporated with water, by means of an alkaline salt or absorbent earth. Till oil is made miscible, it is unable to enter the radical vessels of vegetables; and, on that account, Providence has bountifully supplied all natural soils with chalky or other absorbent particles. I say natural soils, for those which have been assisted by art are full of materials for that purpose; such as lime, marl, soap-ashes, and the volatile alkaline salt of putrid dunghills.

It may be asked, whence do natural soils receive their oily particles? I answer, the air supplies them. During the summer months, the atmosphere is full of putrid exhalations arising from the steam of dunghills, the perspiration of animals, and smoke. Every shower brings down these putrescent particles for the nourishment of plants. Of these, some fall into the sea, where they probably serve for the nourishment of fuci, and other submarine plants. They are, however, but seemingly lost, as the fish taken from the sea, and the weeds thrown upon the beach, restore them again under a different form. Thus Providence, with the most consummate wisdom, keeps up the necessary rotation of things, dissolution and combination following each other in endless succession.

When the putrescent particles that are suspended in the atmosphere happen to fall upon a very sandy soil, the solar heat exhales the most of them. Hence an additional

reason

reason for covering our light soils with herbage during the summer months.

On the contrary, when these particles fall upon stiff land, or such as have been marled or limed, an intimate union is produced, too strong for the solar heat to exhale.

It is observed, that lime mechanically binds a hot sandy soil. We now see that it also fertilizes it; but the farmer must not presume too much upon that quality.

The ingenious Mr. Tull, and others, contend that earth is the food of plants. If so, all soils equally tilled would prove equally prolific. The increased fertility of a well pulverized soil induced him to imagine that the plough could so minutely divide the particles of earth, as to fit them for entering into the roots of plants.

An open soil, if not too light in its own nature, will always produce plentiful crops. It readily receives the air, rains, and dews into its bosom, and at the same time gives the roots of plants a free passage in quest of food. This is the true reason why land well tilled is so remarkably fruitful.

Water is thought, by some, to be the food of vegetables, when in reality it is only the vehicle of nourishment. —Water is an heterogeneous fluid, and is no where to be found pure. It always contains a solution of animal or vegetable substances. These constitute the nourishment of plants, and the element in which they are minutely suspended, acts only as a vehicle in guiding them through the fine vessels of the vegetable body.

The hyacinth, and other bulbous roots, are known to perfect their flowers in pure water. Hence superficial observers have drawn an argument in favour of water being the food of vegetables. But the truth is, the roots, stem, and flowers of such plants are nourished by the

mucilaginous

mucilaginous juices of the bulb, diluted by the surrounding water. This mucilage is just sufficient to perfect the flower—and no more. Such a bulb neither forms seeds, nor sends forth off-sets. At the end of the season it appears weak, shrivelled, and exhausted, and is rendered unfit to produce flowers the succeeding year. A root of the same kind, that has been fed by the oily and mucilaginous juices of the earth, essentially differs in every particular. It has a plump appearance, is full of mucilage—with off-sets upon its sides.

All rich soils, in a state of nature, are thought to contain oil and mucilage; and in those lands which have been under the plough for some years, they are found in proportion to the quantity of putrid dung that has been laid upon them, making an allowance for the crops they have sustained.

To set this matter in a clearer light, let us attend to the effects of manures of an oily nature, and we shall soon be satisfied that oil, however modified and distinguished, is one of the chief things concerned in vegetation.

Rape-dust, when laid upon land, is a speedy and certain manure, though an expensive one, and will generally answer best on a limestone land, or where the soil has been moderately limed.

This species of manure is much esteemed by the farmer. It contains the food of plants ready prepared; but as it is not capable of loosening the soil by any fermentation, the lands upon which it is laid ought to be in excellent tilth. At present, that useful article of husbandry is much diminished in goodness, owing to the improved methods of extracting the oil from the rape. Heat and pressure are employed in a double degree, and every other method is used to the prejudice of the farmer. Some persons, however, are of opinion, that the severe extraction

extraction of the oil does not materially injure the rape-dust.

Farmers that live in the neighbourhood of large towns use abundance of soot. It is an oily manure, but different from the former, containing alkaline salt in its own nature, calculated as well for opening the soil, as for rendering the oily parts miscible with water.

It is observed that the dung of pigeons is a rich and hasty manure. These animals feed chiefly upon grains and oily seeds; it must therefore be expected that their dung should contain a large proportion of oil.

The dung of stable-kept horses is also a strong manure, and should not be used until it has undergone the *putrid ferment*, in order to mix and assimilate its oily, watry, and saline parts. Beans, oats, and hay, contain much oil. The dung of horses, that are kept upon green herbage, is of a weaker kind, containing much less oil. Swine's dung is of a saponaceous and oily nature, and perhaps is the richest of the animal manures. When made into a compost, and applied with judgement; it is excellent both for arable and grass lands. The dung of stall-fed oxen, especially if oil-cake make part of their food, is of a rich quality, and greatly preferable to that of cows and oxen supported by grass only. A farmer, when he purchases dung, should attend to all the circumstances under which it is produced. One load of dung from a hunting stable, where much corn is used, is worth two loads produced by hay and green provender.

The dung of ruminant animals, as cows and sheep, is preferable to that of horses at grass, owing to the quantity of animal juices mixed with their food in chewing. And here I beg leave to remark in general, that the fatter the animal, *cæteris paribus*, the richer the dung.

Human

Human ordure is full of oil and a volatile alkaline salt. By itself it is too strong a manure for any land; it should therefore be made into a compost before it is used. The dung of carnivorous animals is plentifully stored with oil. Animals that feed upon seeds and grains come next, and after them follow those which subsist upon grass only.

To suit these different manures to their proper soils, requires the greatest judgement of the farmer; as what may be proper for one soil may be highly detrimental to another.

In order to strengthen my argument in favour of oil (phlogiston) being the principal food of plants, I must beg leave to observe, that all vegetables, whose seeds are of an oily nature, are found to be remarkable impoverishers of the soil, as hemp, rape, and flax; for which reason, the best manures for lands, worn out by these crops, are such as have a good deal of oil in their composition; but then they must be laid on with lime, chalk, marl, or soap ashes, so as to render the oily particles miscible with water.

The book of Nature may be displayed, to show that oily particles constitute the nourishment of plants in their embryo state; and, by a fair inference, we may suppose that something of the same nature is continued to them as they advance in growth. The oily seeds, as rape, hemp, line, and turnip, consist of two lobes, which, when spread upon the surface, form the seminal leaves. In them the whole oil of the seed is contained. The moisture of the atmosphere penetrates the cuticle of the leaves, and, mixing with the oil, constitutes an emulsion for the nourishment of the plant. The sweetness of this balmy fluid invites the fly, against which no sufficient remedy has, as yet, been discovered. The oleaginous li-

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quor being consumed, the seminal leaves decay, having performed the office of a mother to her tender infant. To persons unacquainted with the analogy between plants and animals, this reflection will appear strange. Nothing, however, is more demonstrable.

Most of the leguminous and farinaceous plants keep their placenta, or seminal leaves, within the earth; in which situation they supply the tender germ with oily nutriment, until its roots are grown sufficiently strong to penetrate the soil. The curious reader will find this subject treated of at large in the third essay.

It is usual to talk of the salts of the earth, but chemistry has not been able to discover any salts in land which has not been manured; though it is said that oil may be readily obtained from every soil, the very sandy ones excepted.

Marl, though a rich manure, has no salts. It is thought by some to contain a small portion of oleaginous matter, and an absorbent earth, of a nature similar to limestone, with a large quantity of clay intermixed.

Lime mixed with clay comes nearest to the nature of marl of any factitious body that we know of, and may be used as such, where it can be had without much expense. By increasing the quantity of clay, it will make an excellent compost for a light sandy soil; but to make the ground fertile, woollen rags, rotten dung, curriers' shavings, or any oily manure, should be incorporated with it some time before it is laid on.

It is the opinion of some, that lime enriches the land it is laid upon, by means of supplying a salt fit for the nourishment of plants; but, by all the experiments than have been made upon lime, it is found to contain no kind of salt. Its operation, therefore, should be considered in a different light. By the fermentation that it induces, the earth

opened

opened and divided, and, by its absorbent and alkaline quality, it unites the oily and watery parts of the soil. It also seems to have the property of collecting the acid of the air, forming with it a combination of great use in vegetation.

From viewing lime in this light, it is probable that it tends to rob the soil of its oily particles, and in time will render it barren, unless we take care to support it with rotten dung, or other manures of an oily nature.

As light sandy soils contain but a small portion of oleaginous particles, we should be extremely cautious not to over do them with lime, unless we can at the same time assist them liberally with rotten dung, shavings of leather, woollen rags, shavings of horn, and other manures of an animal kind. Its great excellence, however, upon a sandy soil, is by mechanically binding the loose particles, and thereby preventing the liquid parts of the manure from escaping out of the reach of the radical fibres of the plants.

Upon clay the effect of lime is different; for, by means of the gentle fermentation that it produces, the unsubdued soil is opened and divided; the manures laid on readily come into contact with every part of it; and the fibres of the plants have full liberty to spread themselves.

It is generally said that lime answers better upon sand than clay. This observation will undoubtedly hold good as long as the farmer continues to lime his clay lands in a scanty manner. Let him treble the quantity, and he will then be convinced that lime is better for clay than sand. It may be justly answered, that the profits will not admit of the expense. I agree. But then it must be understood that it is the application, and not the nature of the lime, that should be called in question. Clay, well limed,

will fall in water, and ferment with acids. Its very nature is changed.

Under such agreeable circumstances, the air, rains, and dews, are freely admitted, and the soil is enabled to retain the nourishment that each of them brings. In consequence of a fermentation raised in the soil, the fixed air is set at liberty, and in that state of activity it becomes an useful instrument in dividing the tenacious clay. However, let the farmer, who uses much lime for his clay lands, be instructed to manure them well, otherwise the soil will bake, and become too hard to permit the roots of the plants to spread themselves in search of food.

It is the nature of lime to attract oils, and dissolve vegetable bodies. Upon these principles we may account for the wonderful effects of lime in the improvement of black moor-land. Moor-earth consists of dissolved, and half-dissolved, vegetable substances. It is full of oil.—Lime dissolves the one, and assimilates the other.

Such lands, not originally worth sixpence *per* acre, may be made, by paring, burning, and liming, to produce plentiful crops of turnips, which may be followed with oats, barley, or grass seeds, according to the inclination of the owner.——These observations, however, are rather foreign from the argument of the present essay, to which I shall now return.

To the universal principle, oil, (phlogiston,) we must add another of great efficacy, though very little understood; I mean the nitrous acid of the air.

That the air does contain the rudiments of nitre, is demonstrable from the manner of making saltpetre in the different parts of the world. The air contains no such salt as perfect nitre; it is a factitious salt, and is made by the nitrous acid falling upon a proper matrix. The makers

makers of nitre form that matrix of the rubbish of old houses, fat earth, and any fixed alkaline salt. The universal acid, as it is called, is attracted by these materials, and forms true nitre, which is rendered pure by means of crystalization, and in that form it is brought to us. In very hot countries, the natural earth forms a matrix for nitre, which makes the operation very short.

It is observed, that nitre is most plentifully formed in winter, when the wind is northerly: hence we may understand the true reason why land is fertilized by being laid up in high ridges during the winter months. The good effects of that operation are wholly attributed to the mechanical action of the frost upon the ground. Light soils, as well as the tough ones, may be exposed in high ridges, but with some limitation, in order to imitate the mud walls in Germany, which are found, by experience, to collect considerable quantities of nitre during the winter.

After saying so much in praise of nitre, it will be expected that I should produce some proofs of its efficacy, when used as a manure. I must confess that experiments do not give us any such proofs. Perhaps too large a quantity has been used; or rather, it could not be restored to the earth with its particles so minutely divided, as when it remained united with the soil, by means of the chemistry of nature. I shall therefore consider this nitrous acid, or, as some call it, the *acidum vagum*, in the light of a vivifying principle, with whose operation we are not yet fully acquainted.

I have already observed, that there subsists a strong analogy between plants and animals. Oil and water seem to make up the nourishment of both. Earth enters very little into the composition of either. It is observed, that animals take in a great many earthy particles at the mouth,

mouth, but they are soon discharged by urine and stool. Vegetables take in the smallest portion imaginable of earth; and the reason is, they have no way to discharge it.

It is highly probable, that the radical fibres of plants take up their nourishment from the earth, in the same manner that the lacteal vessels absorb the nutriment from the intestines; and as the oily and watery parts of our food are perfectly united into a milky liquor, by means of the spittle, pancreatic juice, and bile, before they enter the lacteals, we have all the reason imaginable to keep up the analogy, and suppose that the oleaginous and watery parts of the soil are also incorporated, previous to their being taken up by the absorbent vessels of the plant.

To form a perfect judgement of this, we must reflect that every soil, in a state of nature, has in itself a quantity of absorbent earth, sufficient to incorporate its inherent oil and water; but when we load it with fat manures, it becomes essentially necessary to bestow upon it, at the same time, something to assimilate the parts. Lime, soap-ashes, kelp, marl, and all the alkaline substances, perform that office.

In order to render this operation visible to the senses: —Dissolve one drachm of Russia potash in two ounces of water; then add two spoonfuls of oil. Shake the mixture, and it will instantly become an uniform mass of a whitish colour, adapted, as I conceive, to all the purposes of vegetation.

This easy and familiar experiment is a just representation of what happens after the operation of burn-baking, and consequently may be considered as a confirmation of the hypothesis advanced. Let us attend to the the process.

The

The sward being reduced to ashes, a fixed alkaline salt is produced. The moisture of the atmosphere soon reduces that salt into a fluid state, which, mixing with the soil, brings about an union of the oily and watery parts, in the manner demonstrated by the experiment.

When the under stratum consists of a rich vegetable mould, the effects of burn-baking will be lasting. But when the soil happens to be thin and poor, the first crop frequently suffers before it arrives at maturity.

The farmer, therefore, who is at the expense of paring and burning a thin soil, should bestow upon it a portion of rotten dung, or shambles manure, before the ashes are spread, in order to supply the deficiency of oily particles; and he should be very careful not to keep this kind of land too long under the plough.

In consequence of this prudent management, the crop will be supported during its growth, and the land will be preserved in health and vigour.

For such weak lands, it is highly probable that the oil-compost described in the next essay, will be found the cheapest and most effectual manure.

Hitherto I have considered plants as nourished by their roots. I shall now take a view of them as nourished by their leaves. An attention to this part of the vegetable system is essentially necessary to the rational farmer.

Vegetables that have a succulent leaf, such as vetches, pease, beans, and buck-wheat, draw a great part of their nourishment from the air, and on that account impoverish the soil less than wheat, oats, barley, or rye, the leaves of which are of a firmer texture.

In this manner the vegetable creation renders the air pure by assimilating to itself those putrescent particles which, if not removed, would render the atmosphere unfit for animal respiration. Some modern philosophers have

have attempted to destroy this opinion, but they must bring stronger proofs than those they have produced, before they can expect to tear from the human breast an idea so full of harmony.

Rape and hemp are oil-bearing plants, and, consequently, impoverishers of the soil; but the former less so than the latter, owing to the greater succulency of its leaf.

The leaves of all kinds of grain are succulent for a time; during which period the plants take little from the earth; but as soon as the ear begins to be formed, they lose their softness, and diminish in their attractive power.

The radical fibres are then more vigorously employed in extracting the oily particles of the earth, for the nourishment of the seed. Such, I apprehend, is the course of nature.

On the Advantages of distilling Ardent Spirits, and drying Coffee and other Substances by Steam; and Description of an Instrument for facilitating Evaporation. In a Letter from Mr. CHARLES WYATT *to the Editors.*

GENTLEMEN,

As you thought my patent for distilling * by steam worth a place in your publication, I hope you will indulge me by inserting the following observations.

Having, by repeated and extensive experiments, clearly ascertained the great advantages resulting from the distillation of ardent spirits by steam, I would beg leave to submit, to the consideration of those who may be interested

* See vol. II. p. 9, of the second series of this work.

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in such pursuits, a concise view of what may be expected from a change in the present system of distilling.

The points on which this undertaking, compared with the existing practice, principally rests, are these.

1st. An improvement in the quality of the spirit.

2d. A facility and security in conducting the operation.

3d. A reduction in the labour, and in the duration, of the process.

4th. A reduction in the expense of fuel.

5th. A reduction in the original expense and repair of utensils.

I. *An Improvement in the Quality of the Spirit.*

A Committee of the House of Commons, which sat in the year 1799, to enquire into the state of the Scotch distilleries, reports, that the disagreeable and unwholesome flavour frequently discovered in spiritous liquors, arises from "*rapid distillation. The essential oils, and other* "*particles of an offensive smell and taste, rise in rapid* "*distillation with the spirit, and communicate to it their* "*peculiar flavour.*" In confirmation of this fact, some extracts will be made from the report, and annexed to these observations.

On considering the nature of distillation, it will be obvious, that, to obtain a pure and genuine spirit, no more heat should be applied than will detach the spirit from its basis; although, for the purposes of commerce, great niceties cannot be observed. But "*rapid distillation*" requires great heat. Great heat expels the essential oils, and other adventitious substances; burns the extractive matter that falls to the bottom of the still; and is thus the true source of the depravation of the spirit.

 By

By using steam as the vehicle of heat, it is proposed to remedy these inconveniences. The heat, as applied in this apparatus, can never exceed that of boiling water; the liquor will be constantly attenuated by accessions of condensed steam; the extractive matter cannot be deposited nor burnt; the essential oils cannot in any undue proportion be expelled; and therefore the spirit will rise in a milder and purer state than by the immediate application of fire.

II. *A Facility and Security in conducting the Operation.*

The fire not being in contact with any of the distilling vessels, but with the boiler only, which, by a very simple contrivance, supplies itself with water during the operation, no danger is to be apprehended from any sudden increase of intensity in the fire, nor can it injure either the quality or ultimate quantity of the spirit. One particular convenience is, that the fire may be situated in a distant or an external part of the building.

III. *A Reduction in the Labour, and in the Duration, of the Process.*

To make this intelligible, it is necessary to observe, that the stills are double, *i. e.* one still is placed upon the other, and that steam is let into the lower, but not into the upper still. Both stills are to be charged at once. The roof of the lower still is so constructed, that every particle of steam, on being condensed against it, runs immediately into the refrigeratory; and the heat that evolves in that condensation, passing into the superior charge, prepares it for distillation. The lower charge being let off, the upper charge supplies its place, and begins almost immediately to run. If the upper still contain

contain low wines, the operation will be partly simultaneous. Thus four circumstances concur to accelerate the operation.

1st. No significant time is lost in raising the liquor, the first charge excepted, to the boiling point.

2d. None of the steam that is raised within the lower still, returns in a liquid state into the general mass to be again raised.

3d. Whatever is obtained from the upper still during the simultaneous operation, is so much time of the common process curtailed. And,

Lastly, as no cake will form within, all the time usually required to cool and clean the stills, is here dispensed with.

In fifty successive distillations, the abridgement of the process cannot be so little as 150 hours.

IV. *A Reduction in the Expense of Fuel.*

This is a point of considerable importance. Three hundred pounds weight of Newcastle coal, will produce, from 550 gallons of melasses wash, undergoing two distillations, one puncheon of rum of 110 gallons, hydrometer proof. According to some reports from Jamaica, reports possibly not accurate, this is only one-fifth part of the coal consumed there to produce the like quantity of spirit *. The difference however, even if less in favour of the new system, cannot fail to be an object of solicitude not only to every cultivator of the sugar-cane, but to every manufacturer of ardent spirit. In Scotland,

* Where wood is used as fuel it is necessary to allow 1,089 lbs. of dry oak to 600 lbs. of Newcastle coal, as equal heats are produced by those respective quantities. Vide Thomson's Chemistry.

where the distillation is *urged* by every practicable contrivance, the waste of fuel is enormous.

V. *A Reduction in the original Expense and Repair of Utensils.*

It would be improper here, to state the cost of the apparatus, but it would amount to less money than is usually given for utensils of the common construction; and certainly, as the stills do not come into contact with fire, as no harsh nor destructive incrustation whatever, can attach itself internally to the metal, the decay, and consequently the repair, of the vessels, can hardly be a subject of calculation. It is probable that little or no expense may be incurred on that point, within twenty or thirty years, except for the boiler, which cannot be more than a septennical charge.

THE DISTILLERY in which the experiments leading to these conclusions have been made, is situated on Bankside, and may be any day examined. Some improvements also in other parts of the undertaking, may be properly noticed here.

The fermenting vats; the reservoir containing the condensers; the cisterns for receiving the spirit; are all constructed of brick, laid in, and faced with Roman Cement; and although upwards of 14,000 gallons of wash have been distilled, no perceptible injury has been communicated to any of them, nor have the stills ever been cleaned, except being washed out with warm water. In vats built of these materials, all liquors may be kept cooler than they can be in wood, and their durability is much greater.

Extracts

Extracts from the Report of the Committee of the House of Commons on the Scotch Distilleries in 1799.

"When the wines used for distillation are old, heavy, "or overcharged with thick substances, and a very fine "clear spirit is wished wished for, a quantity of pure "spring water is thrown into the still along with the "wine, and the essential oils must not be forced over in "too great quantities.

"The stills run off in about twelve or fourteen hours, "and when rectifying low spirits require from eighteen "to twenty-two hours. From experience and observa- "tion I have found that spirits are more disagreeable "and fiery when distilled with a great degree of heat "than when distilled by a more moderate one."

Mr. Gordon, of Xeres.

"They who assert that rapid distillation has no in- "fluence upon the taste or flavour of the spirit, either "try to deceive, or are ignorant of the art of distilling.

"Why do we distill fine and delicate liquors in balneo "mariæ? Because the heat is equal and uniform, and "cannot be increased by the vivacity of the fire."

Mr. E. G. I. Crooken.

"I am of opinion that the essential or flavouring oils "cannot be separated so well from the spirits of fer- "mented liquors or washes of any kind by rapid dis- "tillation as by slow distillation." *Dr. Joseph Black.*

"The more rapidly the distillation is carried on, the "more the spirits obtained by it will be infected with "essential oils, and other particles of an offensive smell "and taste, as well as with water or phlegm."

Dr. Ingenhouz.

"I have

"I have no hesitation in asserting, that rapid distilla-
"lation brings over a very strong deleterious spirit,
"containing empyreumatic oil, which is highly obnox-
"ious to the health of those who drink it."

Mr. William Bannerman.

"I have no doubt that spirits are more unwholesome if
"distilled very rapidly, than when distilled slowly, and
"with a gentle heat." *Dr. Skene.*

THE METHOD OF DRYING COFFEE, consists, in exposing it, in a reticulated cylinder, kept in motion, to the action of air, warmed by means of steam *.

The advantages of this method, over stoves and barbacues, are presumed to be these.

1st. The cylinder may be charged with the coffee in its wet state. The draining will neither injure the metal nor the process.

2d. The air may be raised at pleasure to any degree of heat below 180°. No steam or smoke whatever, can intermix with the air.

3d. After having been gradually heated in the cylinder, the coffee may be exposed to a further heat of upwards of 200°, by being spread upon a steam-table.

4th. The steam or vapour escaping from the coffee, can never return upon it in the state of moisture.

5th. The metal, never being heated beyond the boiling point of water, cannot, like metals heated by the immediate contact of fire, impart any prejudicial effluvia to the coffee.

* Although the subjects of this paper have a relation principally to the West India plantations, yet it may be proper to add, that this method of drying coffee may, with little variation, be successfully applied to gunpowder, corn, and other substances, and perhaps to the making of malt.

Description

Description of an Instrument for facilitating Evaporation; invented by Mr. R. Vazie.

It consists of a hollow cylinder, caused to revolve slowly within a boiler, of correspondent form and dimensions. A common roasting jack may be so applied as to give motion to a number of these cylinders.

The principle on which this process is founded, although an imitation only of the natural action of cooling liquors by stirring, never having been applied to manufactures; it is thought that a statement of the result of some experiments, may tend to promote an improvement in the making of sugar.

Two oqual vessels being filled with water, and exposed as nearly as possible to the same degree of heat, the cylinder was applied to one of them; and it was found, that the evaporation in this vessel exceeded the other, in the proportion of three to two, nearly. The heat of the agitated vessel was constantly about 170°, the other constantly 212°.

This indeed is no more than an illustration of the truth of the general theory of evaporation; and nothing new is pretended to be discovered on that subject.

But, a more important purpose than merely assisting evaporation, may arise from the use of this instrument in the manufacture of sugar. *The sugar cannot be burned;* and therefore, all discolouration proceeding from that circumstance would be prevented; nay, it is not improbable, but that the brown colour of Muscovado Sugar may be either removed, or much softened, by this process; and, it is pretty certain, that the grain of the sugar would be materially improved by it.

Lastly. As the process will be shorter than the customary mode, the consumption of fuel will be less.—If it

it should be in the ratio of the time, the saving will be considerable; but on that point nothing certain can at present be said. Experiment alone, can shew what is to be gained by this process; and it is presumed, that it would be impolitic to suffer any theoretical objections, to prevent an investigation, that may be attended with important consequences to the sugar trade.

CHARLES WYATT.

New Bridge-street, Sept. 1303.

Description of a Press for packing all Kinds of Goods with Expedition.

With a Plate.

From the ANNALES DES ARTS.

LIGHT, soft, and elastic substances used in commerce, as wool, cotton, hemp, flax, hops, tobacco, &c. require to be reduced into a small compass, to facilitate their carriage, and to preserve them from the humidity which they would not fail to contract by remaining in warehouses. Underneath will be found the description of a press, invented by M. Buschenderf, which is cheap, easy to be worked, occupies little room, and may not only be employed for packing the above-mentioned substances, but likewise for barrelling herrings and flour, for pressing bales of paper, oil-cloth, and many other purposes. This machine is intended to save the expense of metal vices and screws, which always come very high, or to obviate the necessity of wooden screws, which are very inconvenient when the wood is swelled with humidity, the operation being performed by the action of the lever,

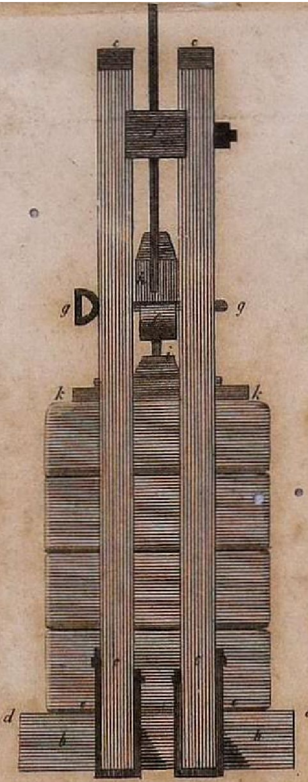

Fig. 3.

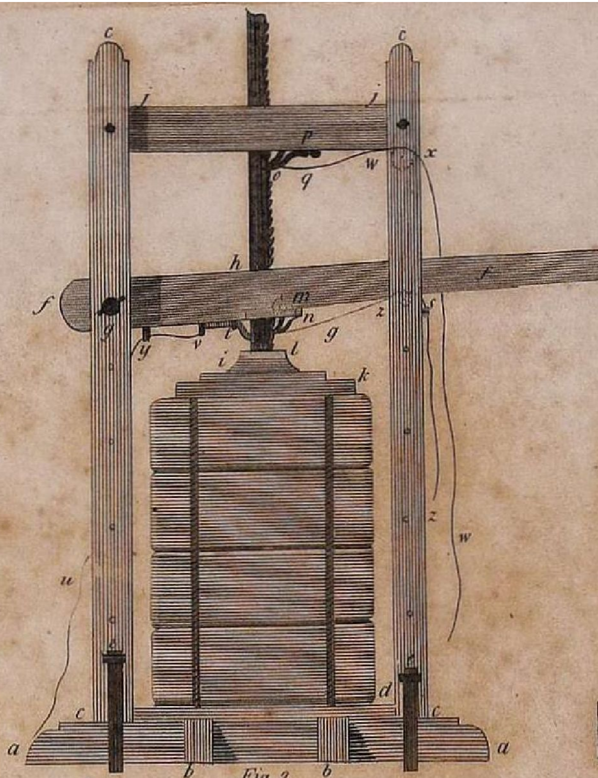

Fig. 2.

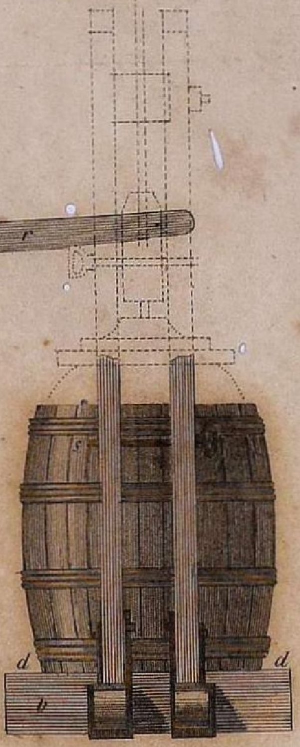

Fig. 4.

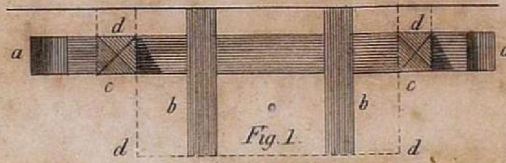

Fig. 1.

1 2 3 4 5 6

Six Pieds du Rhin.

1 2

Deux Mètres.

lever, the power of which may be augmented by increasing its length.

Explanation of Plate XV.

Fig. 1, plan of half the press.

a a, the principal foot of the press.

b, b, cross beams fastened to the feet intended to form a solid frame for the bottom of the press.

c c, section of the two uprights.

d d d d, a square, shewing the bottom of the press, formed with thick oak planks, which cross the beams *b, b*. These planks must be sufficiently strong to resist the pressure.

Fig. 2, elevation of the press, longitudinally.

e, e, iron cramps, fastened with pins and screws, and intended to combine the uprights with the foot of the press.

f f, a lever, by which the pressure is effected.

g, a moveable pin, with a ring at the extremity, for the convenience of drawing it out; it serves as the centre of rotation of the lever. The uprights *c, c*, are perforated at certain distances, for the purpose of changing the position of this pin, as necessity may require.

h, a flat iron bar, cut on one side like a saw; the extremity is joined to a board or plate of metal, beneath which is placed a thick plank *k*, which is laid upon the goods.

l, an iron trigger, turning on the pin *m* (marked by a dotted circle), fixed in the lever *f f*. This trigger is pressed into the indentures of the saw by a spring *n*, that makes it catch.

 That

That the metal plate may not be raised by the elasticity of the materials exposed to the pressure of the machine, the beam *jj* is provided with a similar trigger *o*, turning on a pin *p*, which is made to catch by means of the spring *q*. This trigger prevents the saw-bar from going back when the lever has made it descend a few notches.

It is evident that the manner of working this press consists in the very simple operation of bearing upon the extremity of the lever, and in changing, from time to time, the moveable pin *g*, when its position is somewhat higher than horizontal. In pressing very elastic articles, as wool, &c. it will be proper to suffer the levers to remain stationary for some time. It is unnecessary to observe, that the bales or packages must first be placed properly, together with the cords with which they are to be tied. When the article has been sufficiently pressed the lever is lifted up at *r*, and held in that position, while an iron pin *s* is passed through the holes of the upright on the side opposite to the moveable peg: the position of this pin is seen at *s*, Fig. 4. To disengage the triggers, draw the cords *z z* and *w w*, which are carried over two small pullies; one of them, *x*, is placed beneath the cross-beam, and the other near *s*, under the lever. Their ends are fastened to two small staples, joined to the triggers *l*, *o*, and their springs *n*, *q*; these cords are tied to the moveable pin, while the plate is taken away, and the operation performed. But as these triggers or catches would not keep the flat plate and the saw-bar at a proper height, a flat bolt *t* is fixed behind the bar, provided with a small spring, which drives it into holes, made at proper distances in the back of the bar. A small cord *u*, carried through a staple *y*, and fastened

fastened to the head of the bolt v, serves to draw it out at pleasure when a fresh pressure is required. Thus the mere alteration of this bolt is sufficient to keep the saw and the plate at the proper height when the lever is to be lifted up by the manœuvre just described.

Fig. 3, elevation of the machine from behind; where may be seen the manner of fixing the cramps which join the uprights and the sleepers, and likewise the disposition of the lever and its pin: the same letters correspond to the same parts in all the figures.

Fig. 4. The machine is here seen properly disposed for the pressure of barrels of flour, herrings, &c. For packing casks it is necessary to have a strong round piece of wood, nearly the diameter of the barrel, which is placed above the head, and underneath the flat plate: this disposition facilitates the hooping when the head is pressed down to the notches.

The mortise made in the lever, for the passage of the saw, should be wider towards the top and bottom, to facilitate the movement of the lever, and always in the direction of a radius diverging from its centre of rotation. This mortise might even be provided, in case of necessity, with an iron cramp, or plate, to strengthen the lever: the teeth of the saw should not be cut with an angle too acute, that the catch may take better hold. It would not be amiss to secure the lever round the moveable pin with an iron cramp, to prevent its splitting.

Description of a new Photophorus, or Lamp.

With a Plate.

From the ANNALES DES ARTS.

FOR several years natural philosophers have directed their attention with considerable success to the means of economizing heat, by extracting the greatest possible quantity from a given quantity of combustible. It is not less interesting to apply this principle of economy to the employment of light, of which a considerable loss is daily sustained when a light is required to be cast on only one or more objects *.

It has indeed been long known, that parabolic mirrors possess the property of reflecting parallel with the axis, the rays of light that issue from the focus. The knowledge of this circumstance was connected with that of conic sections, but before M. Berard nobody ever constructed a lamp on these principles, at once simple, convenient, cheap, economical of the combustible, affording an equal and steady light, the direction of which may be varied at pleasure, and not fatigue the sight.

Every one is acquainted with that kind of reverberators in the form of a truncated cone, placed above the light, so that the axis of the cone may be vertical, and that the smoke of the light which is in this axis may escape by the small aperture at top. These reverberators produce little effect, for the reasons that will presently appear.

Lambert, in the Memoirs of Berlin for the year 1770, has given the description of a very imperfect reflecting

* We should imagine the author of this paper to have been ignorant of the excellent experiments on this subject made by Count Rumford, and published in the fourth volume of the first series of this work.

photophorus.

photophorus. M. Berard, in a photophorus of his own invention, has corrected all the defects attributed to that instrument: for, while meditating on the means of perfecting Lambert's lamp, his ideas were naturally directed towards the paraboloïd, which surface, as we know, possesses the exclusive property of reflecting parallel with its axis the rays which proceed from its focus. Such is the ground-work of his invention.

Explanation of Plate XVI.

Fig. 1, represents the paraboloïd in perspective, exhibiting three distinct parts: 1, a paraboloïd formed by the revolution upon its axis of a parabola, the parameter of which is 54 millimetres (2 inches), and the length of the axis 150 (or 5 inches 6 lines); 2, a candlestick or pedestal supporting the paraboloïd; 3, the reservoirs and channels for the oil, consisting of two cylindrical boxes, which contain two others, and two vertical pipes communicating with the boxes by means of another horizontal pipe, from the middle of which rises a small vertical pipe for the wick; this last runs into the interior of the paraboloïd, so that the centre of the flame always coincides with the focus.

To this sketch we shall add the following particulars.

1. The paraboloïd, at the two extremities of its parameter, has two small horizontal axes R, R, Fig. 3, round which the lamp, properly so called, balances itself by a rotatory motion.

2. The paraboloïd has in its lower meridian a groove or crevice T X, Fig. 2, through which passes the pipe with the wick in its oscillations round the axis R R, and in its upper meridian a hole P Q, by which the smoke is conveyed into a chimney, which opens upwards by means of a hinge 2.

3. The

3. The paraboloïd is fixed to the candlestick by a flat hinge fastened with a screw H, by means of which the direction of the light may be varied at pleasure.

4. The vertical pipes of the lamp have two channels, by means of which the lamp is raised in order to snuff, to light, or to extinguish the wick, by sliding the extremities of the axes upwards in these channels L, Z, Fig. 4, which pushes the wick through the hole of the chimney.

We shall now consider separately each of the pieces composing these principal parts.

The parabolic mirror is the principal and the most important part: there are several processes for making it.

First Process. A conical and truncated zone is made and soldered upon a parabolic mould. The zone is then beat cold, till the whole coincides with a parabola cut in wood or pasteboard, which is very easily procured. To form the zone, take a sector of 129° in a circle, the radius of which is 260 millimetres; take from it a concentric sector, of a radius of 150 millimetres; there will then be left a portion of a circular plain crown, which, being bent back, forms the conic zone. This is soldered to a parabolic cap, the aperture of which is 109 millimetres, coinciding with that of the zone, and whose arch is 54 millimetres. In this first process plates of brass or tin, about a millimetre in thickness, are employed.

Second Process. Procure a circle of brass, a millimetre and a half thick, and about 250 millimetres in diameter, to be wrought by a coppersmith. If the copper be without flaw, and of the proper quality, the interior of this paraboloïd of a single piece may very easily be made to coincide with a parabola cut in wood.

In

In this second process, as well as the first, the mirror is polished successively with pumice-stone, charcoal, tripoli, and rotten stone: the polishing is soon performed: the mirror when finished weighs about 6 hecto-grammes (a little more than a pound). For this second process copper may likewise be employed, as it is much easier to beat out than brass, but in that case the mirror must be silvered. This kind of mirror is always preferable when they are required to be of large dimensions.

Third Process. The best method of making the mirror would doubtless be, to cast it of the composition used for the mirrors of telescopes, or rather of platina. More powerful effects would certainly be obtained from such mirrors, but they would be too expensive for an instrument for common use, and very inconvenient on account of their weight.

If the mirror is not intended to be of larger dimensions than those stated above, the process of casting may be employed to advantage by using brass, which, being less brittle, requires less trouble in polishing, and may be reduced by turning to a proper thickness.

The two first processes are preferable, being less expensive, when only one or two mirrors are intended to be made; but the third is better for making a greater number.

There is one observation which applies equally to the three processes: that though accuracy be required in the curvature of the mirror, yet the highest degree of perfection in this curve is not absolutely necessary. As it is only desired to unite within the compass of a cylinder the rays emanating from a luminous point to direct them to an object not very far distant, we may be sure that a small defect of parallelism in a ray will not prevent it from falling upon some part of the object that is intended

to

to be lighted. The same is not the case in the inverse proposition as in the burning glass, to unite the parallel rays in the smallest possible space; here the highest perfection in the curve of the mirror is indispensable to produce the desired effect.

The mirror being completed, trace on the convex surface, with a pasteboard rule, two meridians, intersecting each other at right angles at the south pole, which must previously be determined: these two meridians, which are easily traced by means of a circle and two perpendicular diameters drawn upon a table, fix the position of the chimney P Q, the hinge M N, the groove T X, and the axes R, R, which are prolongations of the parameter. Let us consider each of these parts separately.

The aperture P Q, made in the paraboloïd for the passage of the smoke, should be as small as possible, and yet sufficiently wide to preserve the mirror from the smoke in every position. If we suppose that the smoke never diverges more than in an angle of 15°, and then imagine a cone, with an aperture of 30°, whose top is in the focus of the mirror, and its axis in the prolongation of the wick; this cone, penetrating the paraboloïd in these different positions from where its axis is horizontal to where it is inclined 35°, will form an aperture of an oval figure, which widens from the pole, as in Fig. 6: it begins at 9 millimetres from the pole S; it is in length 38 millimetres, its greatest breadth is 18, and its smallest 11 millimetres.

The aperture of the mirror is covered by the chimney, properly so called, which has the form of a quadrangular, truncated pyramid; the base is a trapezium, one side of which is 25 millimetres, the parallel side 18 millimetres, and the two others, which are equal, are together 44 millimetres. The superior base is a trapezium, one side of which is 9 millimetres, the parallel side

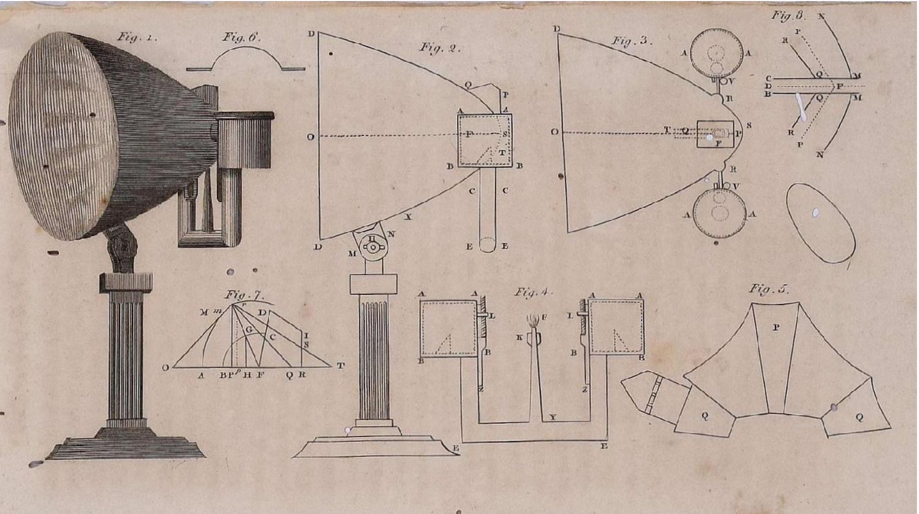

Fig. 1.
Fig. 6.
Fig. 2.
Fig. 3.
Fig. 8.
Fig. 7.
Fig. 4.
Fig. 5.

side 5 millimetres, and the two others being equal, are together 16 millimetres. At Q this pyramid has a tail, terminating in a hinge, on which it turns upwards. Fig. 5, exhibits a developement of this pyramid, made in a single piece, and which bends so that the two edges Q, Q, fold over each other. The right angle of the lower base has rather concave sides, to fit the paraboloïd exactly.

The form and dimensions of this chimney are so contrived as to collect the smoke in its centre, and to preserve the mirror from it in every position: it prevents all agitation in the circum-ambient air, preserves the intensity of the flame in a remarkable manner, by producing a current of air from top to bottom. When the axis of the paraboloïd is horizontal, the side Q of the chimney is inclined about 45°; and when the axis is inclined 35°, the side P is likewise inclined 45°, so that in the two extreme positions the smoke is always driven to the centre of the chimney. If this were not the case, the photophorus would lose all its advantages.

To fix the two axes R, R, which are prolongations of the parameter, and which serve as a pivot to the lamp; the two points R, R, which are the extremities of the parameter, and are distant from the pole $31\frac{1}{2}$ millimetres, more or less, according to the thickness of the copper, must be exactly marked by means of a wooden ruler, in which must be cut a portion of the parabola, forming an arch of $13\frac{1}{2}$ millimetres, exclusive of the thickness of the mirror at the pole. A piece of iron wire, 3 millimetres in diameter, must then be bent, so that after passing round the outside of the parabola its two extremities may be in a right line, as in Fig. 6. This iron wire being soldered at the two points R, R, already found, the curved part is cut off. Lastly, to render the two axes

axes more solid, they may be inclosed in a small spherical segment R, likewise soldered to this paraboloïd.

The magnitude, figure, and position, of the aperture T X, which the pipe with the wick passes through, are determined by the penetration of this pipe in the various positions of the mirror. Its length T X is 68 millimetres, its distance T S from the pole 27, its least width 7, and its greatest width 11; it is rounded at its two extremities.

The flat hinge H is composed of two rectangular pieces of copper, 27 millimetres in breadth, 40 in length, and 2 thick, and a circle of the same thickness, and 27 millimetres in diameter. The two rectangular pieces terminate on one side in semi-circles, and on the other are bent into a right angle, the contrary way, so as to form a base M N, which is soldered to the paraboloïd. The two rectangular pieces fit close to the circle, which terminates in a cylindrical or somewhat conical tail, which enters the hollow of the candlestick, whose height is 160 millimetres, and its diameter at the base 140 millimetres. A screw with a square head goes through the three parts of the hinge at their common centre.

A line, passing between the two rectangular pieces of the hinge, ought at the same time to go through the middle of the aperture T X, and of the chimney P Q, as also through the axis S O of the paraboloïd. In fixing the screw the greatest attention must be paid that in every position of the paraboloïd the parameter R R, and consequently the reservoirs of oil, remain horizontal.

The distance, M D, from the base to the aperture of the paraboloïd is 27 millimetres: if this distance were augmented, the hinge would injure the horizontal pipe E E, at the extreme inclination of the paraboloïd. On the other hand, if M D were smaller, the centre of gravity

gravity of the photophorus would be too far distant from the axis of the chandelier, and there would be less stability in the machine; besides, the pole would be too far from the axis of the chandelier, and the pole of the paraboloïd would be more liable to injury on the chimney-piece of an apartment.

A A, B B, Figs. 3 and 4, are cylindrical boxes, of block-tin, being 45 millimetres in diameter, and the same in height. These boxes, which have no tops, contain two others; between the two there is a vacancy of a millimetre, intended to promote the current of air, and between the bottoms is a vacancy of 4 millimetres. In the centre of the bottom of the exterior box is fixed vertically an iron spike, 14 millimetres in length. The bottom of the inside boxes has a hole, 15 millimetres in diameter: this hole is covered by a tin plate, covered with lead, and which opens by a small hinge, to an inclination of 60°: it is lifted up by means of the iron spike.

The bottoms B, B, of the outside boxes, communicate with the two vertical pipes B E, B E, which are 13 millimetres in diameter, and 81 in length. These two pipes are soldered to the reservoirs in such a manner that the respective surfaces exactly meet at B, and that no projection may prevent the passage of the fluid from the reservoirs.

To the extremities E, E, is soldered, at a right angle, another pipe, of the same diameter as the preceding B *e*, the length of which, measured between the two, is 100 millimetres.

In the middle of the pipe E E rises vertically the pipe Y, with the wick. It is somewhat conical; its diameter at Y is 7 millimetres, at the upper end 3 or 4, according

 to

to the thickness that the wick is intended to be. The top is elevated 23 millimetres above the bottom of the reservoirs B, B; the whole length to Y is 88 millimetres.

K, is a double pipe, 11 millimetres in diameter, and 7 in height, which envelopes the end of the pipe with the wick, so as to leave a vacancy of a millimetre between them; its top is not so high by two millimetres as that of the pipe with the wick. The object of this double pipe is to collect the oil which the heat may cause to run down the pipe with the wick, and to lead it back into it by means of one or two small holes made in the latter, and which communicate with the vacant interval. This contrivance saves the oil which runs from the wick; an inconvenience to which most lamps, and even those with a double current of air, are liable.

The vertical channel L Z is formed of a plate of iron, 5 millimetres broad and 154 in length; it is bent in such a manner as to leave a hollow of three millimetres between its two parallel but unequal branches, the longest of which is level with the top of the boxes, and the other commences 9 millimetres lower down: the longest branch was at first 9 millimetres wide by 27 long; this part is afterwards twisted in the form of a screw, upon which is put a small nut F, which moves up and down, bearing on one side against the reservoir, and on the other the smaller branch of the pipe: it is by these nuts that the lamp rests upon the axes R, R, of the paraboloïd.

The following is the manner of using the photophorus.

Supposing the different pieces of the machine are separate, the first point is to put them together.

1. Introduce the stalk of the hinge H into the hollow of the candlestick.

2. Introduce

2. Introduce the circle joined to the stalk into the cavity formed by the two pieces M, N, fixed to the mirror, and screw them together with the screw.

3. Introduce the upper end of the pipe with the wick into the lower extremity X of the aperture T X; and in placing the lamp, which must be held by the horizontal pipe, put the two axes R, R, into the channels L, Z, then lower the screws L, L, till the extremities of the axes R, R, correspond at about 15 millimetres below the top of the boxes.

4. Make a wick of cotton, or other substance; fasten one end of it to a piece of wire, by which means it may easily be introduced into the pipe that is to receive it.

5. Into the reservoirs *a*, *b*, pour nut or olive oil till the vertical pipes are full; afterwards fill the inner boxes, introduce them gently, and both together, if possible, into the reservoirs. At this moment, the iron spikes having raised the tin plates which cover the holes at the bottom of these boxes, a small quantity of oil will run between the box and the reservoir to the height of some millimetres. As the wick burns the oil descends till it comes to be level with those plates. A few bubbles of air then introduce themselves through the aperture, and ascend through the oil in the boxes, to occupy the vacant space. The addition of these bubbles augments the power of the rarefied air contained there, and makes fresh oil run through these apertures till an equilibrium is established between the external air and that inclosed above the oil; this operation continues till all the oil in the boxes is consumed.

6. When the lamp is provided with cotton and oil there is nothing more to be done than to light the wick; for this purpose, after having raised the lamp vertically till

till the pipe with the wick rises through the aperture of the chimney, it is then lighted, and let down in the same manner. In this movement the axes R, R, run freely in the vertical channels.

7. When the wick is lighted it is necessary to examine whether the centre or principal point of the light coincide with the focus *f* of the paraboloïd. This is very easily effected, by turning the screws till the light is as lively and as equal as possible. The position of the screws when once found cannot vary, at least not perceptibly, as long as the burning portion of the wick does not alter in length or thickness. The length ought not to exceed 6 millimetres, that it may not be consumed too rapidly.

8. In order to snuff or extinguish the match, the same operation is necessary as for lighting it.

9. To use the photophorus, the proper inclination must be given to it according to the distance at which we want to read or write. The axis of the paraboloïd may form an inclination of 35 or 40 degrees with the horizon.

10. Care must be taken to wipe the mirror frequently with a linen cloth, and to clean it sometimes with dry whiting, or rather with rotten stone. The pipes for the oil must likewise be cleansed with ley of ashes; and a wire must be passed between the pipe for the wick and the double pipe fixed upon it to clear out the snuff that may insinuate itself, and occasion the oil to run over.

11. When the lamp is to be removed from one place to another, and is lighted, in order to prevent the flame from blackening the mirror, raise the flame into the chimney.

Of

Of the Effects and the Advantages of the Photophorus.

Those who recollect the defects that we observed in Lambert's photophorus, will see that they have all been avoided in the construction of that above described. The following are its effects.

1. The intensity of the light is much greater than in Lambert's photophorus. With the present a person may read a book at the distance of twenty metres (yards), while, with the same light, the same character cannot be read at a greater distance than half a metre.

2. The reflected light is of the same colour as the direct light, if the mirrors be silvered: if they be of copper, the reflected light is rather yellow, which however is not disagreeable to the eye. The former do not tarnish so soon, but if they be rubbed the silver quickly comes off: the second are more easily oxydated, tarnish more readily, but the polish may be renewed as often as we please with rotten stone.

3. The light is equal and uniform at the distance of a metre: at the aperture of the mirror, indeed, are observed several concentric circles, more or less luminous, and in the middle a small bright spot; but these circles soon disappear, and at the distance of two or three decimetres there remains only the bright spot; and the light afforded by it is of the most lively and agreeable kind.

4. The facility of varying the direction at pleasure is an important advantage which renders the photophorus more extensively useful.

5. The solidity of the light is such that the flame never quits the vertical position; and I have observed that the undulatory motion of the light in most other lamps is extremely injurious to the sight.

6. The

6. The paper being the only object in the room upon which the light falls, the retina is sensible only to the impression produced by the paper; hence it results, that the effect of the light is in fact augmented, and that the eyes are less fatigued. It is by a similar effect that a light, which cannot be perceived in the day-time at the distance of a few metres, may be seen at night at the distance of a myriametre, and that any object may be seen better by looking at it through a long black tube, though without glass, than by the naked eye.

7. The expense of oil for this lamp is less than for others, for many reasons: the reservoirs contain about 120 grammes (4 ounces) of oil, which last twenty-four hours without the necessity of a fresh supply, or even of touching the lamp.

Utility of the two independent Movements in the Photophorus.

We might be tempted to simplify the mechanism of the photophorus by making the lamp immoveable on its pedestal, and making the paraboloïd turn round its parameter. There would indeed be one movement less, and consequently more simplicity, but the gain would only be illusory, and we should lose an inestimable advantage, which is obtained by the movement of the axes in the channels, that of being able to light, extinguish, and snuff the wick on the outside of the mirror.

Of Cases in which the circular Wick may be adapted to the Photophorus.

It would not be difficult to adapt to this lamp a circular wick, surrounded with a glass tube, as in Argand's lamps. The following are the inconveniences with which it would be attended: all the points of the flame not be-

ing

ing at the focus, the rays would not be kept parallel; there would be a greater consumption of oil, less facility in snuffing, lighting, extinguishing, &c.; but these disadvantages would diminish in proportion to the magnitude of the mirror: thus when the photophorus is intended to light a great space, as a corridor, a gallery, &c. it would be proper to adapt to it the circular wick, &c. The proportions of the mirror ought in this case to be different; its parameter should then be about 100 millimetres, its diameter 200, and the pipe for the wick should be 12 millimetres in diameter.

Property of double Reservoirs, to prevent the Loss of Oil by the Wick.

By the disposition of the reservoirs, with regard to the wick, the latter is placed exactly in the centre of all the oscillations which the oil experiences by the vibration of the lamp in every direction, so that the level of the oil does not change in the pipe for the wick, though it varies in the reservoirs. This property, which belongs exclusively to the lamp with double reservoirs, is extremely useful to prevent the loss of oil by the wick. This advantage would not exist if the reservoir were in one piece, and surrounded the mirror in a circular form; the oil would then run over at the wick upon the smallest agitation of the photophorus, which would likewise be more inconvenient on account of its augmentation in size at the pole.

Method of using the Photophorus like a common Lamp.

The photophorus may be employed in lighting any apartment like a common lamp; for this purpose it is sufficient to raise the wick above the chimney, as if to light

light it, and to keep it in that position by means of a small catch. In this manner it may also be used for warming a coffee-pot, standing on two bars of iron-wire, supported by the reservoirs.

From the experiments made before the Conservatory of Arts and the Council of Mines, it appears that the photophorus, in its present state of simplicity and perfection, is susceptible of numerous applications. It is useful to the man of letters, the artist, and all those who read, write, draw, or are employed in any other occupation by night. It is of particular advantage to those who are fond of reading in bed. Its utility will be found very great for embossing, by its throwing a stream of light upon the work in any given direction. It may be employed with economy in lighting corridors, and particularly the galleries of mines, at the bottom of which common lights expire when they have consumed all the surrounding oxygen gas; for the photophorus may be fixed in places where the air can be renewed, and directed to any side at pleasure. Its application will be found serviceable in all manufactories where a number of workmen are employed in a row.

The above description was necessary to explain the following letter of the inventor, M. Berard, to the editor.

I have given the description of a photophorus, affording an equal and steady light, by which a book may be read at the distance of 20 metres with a wick consuming only 125 grammes (4 ounces) of oil in twenty-four hours.

As that instrument can light only one person, or several placed in a right line, I have since endeavoured to discover the most convenient form for lighting equally, and at the same time, several workmen, placed in a circular

cular manner. The following has appeared the most simple and effectual.

Fig. 8 represents the vertical section through the centre of the photophorus. M N, M N, are two portions of the parabola, which have a parameter of 80 millimetres, a common focus at F, and axes F P, F P, 200 millimetres in length, forming between them an angle of 110 degrees.

Q R, Q R, are two other portions of the parabola, having the same focus and the same axes, but whose parameter is only 20 millimetres.

This being the case, if we consider that the four parabolas turn round the line F D like an axis, the two parabolas M N, M N, will, as they revolve, describe a figure like a flat bowl, and the two others Q R, Q R, will form another surface nearly of the figure of a cone.

Let us now suppose these two surfaces of tin, brass, or rather of silvered copper, are each fixed in their respective positions by three small supporters, and that through the two apertures M M and Q Q made in the centre, a candle or wick has been introduced, it is obvious that when the machine is placed vertically over the centre of a round table, all the rays reflected by the two mirrors will form on the table a ring or circular crown of light, around which the people at work will enjoy an equal portion of reflected light.

This photophorus, which may be called circular, since it unites all the rays into a circular form, while the rest of the apartment is half obscure, may be adapted to every round table of any magnitude, by being raised more or less above the table.

Ellipses may be taken instead of parabolas as the curve for forming the two mirrors; the luminous ring would

 be

be smaller, and the light would consequently be more intense; but, on the other hand, the same photophorus could not be advantageously adapted to tables of various dimensions. This inconvenience caused me to prefer the parabola to the ellipsis; I only made the lower parabolas Q R, Q R, of a smaller parameter, to diminish the magnitude of the illuminated zone.

Notice on a Method of giving to Hemp and Flax the Appearance of Cotton. By M. Berthollet.

From the Journal de l'Ecole Polytechnique.

When I turned my attention to the application of oxygenated muriatic acid to the art of bleaching, I made experiments with it upon flax and hemp, and in the first volume of the Elements of Dying, page 258, I spoke of it in the following terms: "I endeavoured to bleach, completely, hemp and flax, in a state ready for spinning, by the method that I employ for thread; but though its filaments lose little of their solidity, yet they acquire so great a disposition to separate and divide, that they are much more difficult to spin, and make a much weaker thread."

Since that time, different artists have endeavoured, with more or less success, to extract from hemp and flax a material resembling cotton. An Helvetian, M. Clays, has even for some time possessed an establishment in which he prepares this material.

I am ignorant of the processes which have hitherto been employed, but, by means of the oxygenated muriatic acid, I have succeeded in obtaining a material

more

more beautiful than any of those with which I am acquainted.

The very simple process which I am going to describe was executed in the laboratory of the Polytechnic School by M. Gai Lussac, then a pupil of that school.

The hemp or flax is cut into fragments of about six centimetres in length, and covered with water, in which it is left three or four days. It is then subjected to ebullition in clear water, washed with care, passed through ley, and likewise through oxygenated muriatic acid. Four immersions in oxygenated muriatic acid, and four leys, are commonly sufficient; after which it is passed through a water-bath, in which are mixed a two-hundredth part of sulphuric acid. When taken out of this warm bath, in which it is left about half an hour, it is washed with great care, and immersed in water charged with soap: it is then spread out, without being wrung, on hurdles, where it is left to dry, but not entirely. All these operations, from the first immersion to desiccation, require only five or six hours for a small quantity.

The hemp and flax thus prepared was given to M. Molar, who engaged to perform the mechanical operations. By him it was first combed and then carded. He experienced some difficulty on account of the knots that were formed; but that able mechanician soon surmounted this obstacle.

On the 6 Prairial, year 8 (1800), I presented to the class of physical and mathematical sciences of the Institute, a specimen of the prepared material, equal to cotton in whiteness, and other apparent qualities; but M. Molar found fault that it was too short.

M. Bawens has likewise wrought the cottonny material prepared in the laboratory of the school, by means of

of the capital machines at his manufacture of Chaillot. He experienced no difficulty in the execution; but he likewise found the filaments too short, though it made thread of extreme fineness, and sufficiently strong.

It is therefore the inconvenience of being reduced into too short filaments, that ought to be corrected in the first preparation; and I think a certain method of doing it is not to finish the bleaching, but to stop at the third operation. If four be required to finish the bleaching, the fourth must be performed on the thread, or on the stuff.

In the operation of bleaching, the leys must not be applied too strong, but they should be employed boiling hot. We are assured, that every method of diminishing the smell of oxygenated muriatic acid weakens its action; so that it must be employed pure, and no attempt must be made to prevent the smell but by the construction of the apparatus, and the mode of application; it must even be used in a state of concentration, if we would not be obliged greatly to multiply the operations.

The process is completed by immersion in water charged with soap, without wringing, that the filaments may not contract too much adhesion by desiccation, but may be easily separated by the operation of carding. But, probably by preventing too great desiccation, this inconvenience, experienced in the first trials, would not take place, and this immersion might be dispensed with.

It is remarkable, that whether the finest flax or the coarsest hemp-tow be employed, filaments equally fine and white are obtained.

This notice will be a sufficient guide for bleaching, to artists already accustomed to chemical manipulations.

But

But I can say nothing respecting the mechanical operations of carding and spinning, as they were not executed by me.

If I am not mistaken, this application of a process, which is already old, may afford great advantages, since the spinning, which before required a wheel, may be performed with much less expense, by means of machines, while a gross product of our agriculture, even the refuse of rope-walks, may be converted into a substance precious for the arts. This is the motive which has induced me to insert this notice in the journal of an institution peculiarly devoted to public utility, though it contains nothing new in a scientific point of view.

Transactions of Societies for promoting useful Knowledge.

Society of National Economy of Harlem.

AT a general meeting of this Society, the following prize questions were proposed.

What kind of nettle can be employed in making thread? The memoir must mention the country which produces it, the time of gathering, and describe the method of preparation. It must likewise be accompanied with twenty-five pounds of thread made of that plant. The prize will be 25 ducats, and it will be augmented if 50 lbs. instead of 25 be presented to the Society.

The subject for the second prize is, Can the acorn be employed in domestic economy, for making oil, as a substitute for coffee, &c. and what is the best method of preparing it? The prize is six ducats.

The third question is, What is the present state of public and private economy in Holland?

The

The fourth relates to the best method of preventing or curing the rot in sheep. The prize is 25 ducats, and 50 for the person who shall point out the cause of this disease, and the method of preventing it. All the above memoirs must be transmitted to the secretary of the Society before 30 September, 1804.

Millet being little cultivated in Holland, as no good method is yet known for separating it from the chaff, the Society offers a prize of 25 ducats to the inventor of a machine proper for that operation, and by means of which the millet can be as well separated as that imported from other countries. The competition will remain open till 30 September, 1805.

Society of Rouen.

The account of the public meeting of the Society of Sciences, Literature, and Arts, held at Rouen on 29th June, among other interesting subjects, contains the following.

1. Comparative experiments on the consumption of wood in the furnaces of dyers and others with that of furnaces on the new construction, in which the economy of fuel has been successfully attempted. M. Hæner, of Nancy, appears to have completely fulfilled this aim in the construction of furnaces in his porcelain manufactory.

2. A memoir on the disadvantages of spreading lime as manure on clover, and the injury sustained by young horses that are fed with such clover.

3. Another memoir, on lime considered as forming a cement impenetrable to water or any liquid.

4. A memoir on the methods of driving piles with much less exertion than by those hitherto in use.

5. Observations on bees and silk-worms, and the advantages attending their culture.

Economical

Economical Society of St. Petersburg.

The following are the prize-questions proposed by the Economical Society of St. Petersburgh for the year 1803.

1. By what means can a spirit of activity and industry be excited among the people, particularly the wives and children of the peasantry, in order to encourage the habitude of the labours necessary for their wants? The prize is a gold medal of 50 ducats, founded by the minister and privy counsellor Dmitri Prokosiewitsch Trochtschinskoi.

2. How can the poor in the hospitals of Russia be usefully employed, so that, if they be fed according to the principles of Voght and Rumford, they may be enabled to earn something in addition by labours useful to the state or to the soldiery? The prize is a gold medal of 30 ducats, given by Count Dmitri Iwanowitsch Chevostoff.

3. To propose a good method, suited to the capacity of the Russian peasant, for the preservation of his health, and to enable him to apply remedies himself in most indispositions; or an elementary work on health, for the common people of Russia, pointing out the best preservatives, extracted from indigenous plants, their preparation, and the manner of employing them. The prize is a gold medal of 50 ducats, given by the Senator Mich. Nikitisch Murawieff.

4. What means can be employed to induce the Russian peasant to learn a handicraft business, in which he and his family might be usefully engaged during the winter? The prize consists of a medal, presented for this purpose by the Catholic Metropolitan Stanislaus Sestrenzewitsch.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Explosion of a Steam-Engine.

ON Thursday, the 15th instant, a steam-engine, erected by Messrs. Vivian and Trevithick, near Woolwich, suddenly blew up, and laid the whole of the buildings in ruins. Three men were killed on the spot, one of whom was thrown 170 feet; of two others who were wounded, one is since dead, and another, who was returning to his work, lost his hearing for several hours. A piece of the boiler, 4 cwt. was thrown 350 feet, and some of the bricks 600 feet from the furnace. The cause of this accident has not been ascertained, but it was probably owing to the over-loading of the safety-valve. It was a double engine, of about eight or ten-horse power, four-feet stroke, and ten-inch cylinder. The boiler was of cast-iron, five feet six inches diameter, its average thickness about one inch and a quarter.

Method of preserving Metals from Rust.

M. Conté has discovered a method of preventing the oxydation of iron and steel, or, in the language of common life, to prevent those materials from rusting. This method consists in mixing with oil-varnish at least one-half, or at most four-fifths, of highly rectified spirit of turpentine, according to the greater or less degree of durability that is intended to be produced by it. This varnish is lightly and equally applied, with a sponge, to any article, after which it is put in some place out of the dust. It is asserted, that articles varnished in this manner preserve their metallic lustre, and never contract the

smallest

smallest spot of rust. This varnish may likewise be applied to copper, the polish of which it preserves and heightens in colour. It must prove of particular advantage to preserve philosophical instruments from any alteration in experiments in which they are exposed to water, and consequently rendered liable to rust.

Solar Spectrum.

From some experiments made by M. Ritter, of Jena, on the visible rays of the Solar Spectrum, he concludes, that there exist, without the spectrum, and at its two extremities, invisible rays, which possess the property of assisting oxygenation and disoxygenation. He has also observed a singular coincidence between these effects and those of Galvanism; for the eye, when placed in contact with the negative conductor of the pile, sees every object *red*, but if placed against the positive conductor, it sees them *blue*; whence there appears to result an analogy between the action of the negative electricity and that of red light, and of the positive and the violet light.

Aërostation.

Mr. Robertson, about the middle of July, ascended in a balloon from Hamburgh, accompanied by Mr. Lhoest. They ascended to the height of 2,600 toises, when the cold became so intense as to compel them to descend, which they did near Winsen on the Lake; but the inhabitants, taking them for spectres, fled with the utmost consternation, carrying with them their cattle, &c.; and the aëronauts, fearful of being fired at, were obliged to reascend, and continued their voyage to Winchtenbeck, near Zell, having traversed over a space of twenty-five French leagues in five hours.

Mr. Robertson's aërial excursion was undertaken for scientific purposes, and he has lately published the fol-

 lowing

lowing account (being the second) of his journey and experiments.

"When the balloon rose, says he, the barometer was at twenty-eight inches. At eleven o'clock the machine, which had not been entirely filled, became so dilated that the inflammable air issued with a loud noise from the lower tube. As this aperture was not sufficient, I was obliged to open the upper valve. It remained open nearly a quarter of an hour, during which the balloon ascended in a perpendicular direction: at intervals we threw out some ballast. The atmosphere below us was serene, but above us it was somewhat cloudy.

"Although we approached the sun, the heat decreased as we ascended, and we could look at that luminary without being dazzled. When the barometer was at 14 inches, it appeared to become stationary. The thermometer was at $4\frac{1}{2}$ degrees below Zero; the cold was not excessive, but the singing in my ears ceased, and all our faculties seemed to be palsied by a general indisposition. Having taken some wine to recruit our strength, we threw out some ballast, the mercury in the barometer fell to $12\frac{1}{4}$ inches. At that height the cold out of the car was insupportable, although the thermometer was only one degree below the freezing point. We were obliged to respire faster, and our pulse beat with extreme rapidity. We could scarcely resist the strong inclination to sleep with which we were seized. The blood rushed to our heads, and Mr. Lhoest remarked that it had entered my eyes; my head was so swelled I could not put on my hat."

In this region, where the balloon was invisible from the earth, Mr. Robertson made the following experiments.

1. Having let a drop of ether fall on a piece of glass, it evaporated in four seconds.

2. He

2. He electrified by friction glass and sealing wax. These substances gave no signs of electricity which could be communicated to other bodies. The voltaic pile, which, when the balloon was set free from the earth, acted with its full force, gave only a tenth part of its electricity.

3. The dipping needle seemed to have lost its magnetic virtue, and could not be brought to that direction which it had at the surface of the earth.

4. He struck with a hammer oxygenated muriate of potash. The explosion occasioned a sharp noise, which, though not very strong, was insufferable to the ear. It is also to be observed, that though the aëronauts spoke very loud, they could with great difficulty hear each other.

5. At that height Mr. Robertson was not able to extract any electricity from the atmospheric electrometer and condensor.

6. In consequence of a suggestion from Professor Hermbstadt, of Berlin, Mr. Robertson carried with him two birds; the rarefaction of the air killed one of them; the other was not able to fly; it lay extended on its back, but fluttered with its wings.

7. Water began to boil by means of a moderate degree of heat maintained with quicklime.

8. According to observations made, it appears that the clouds never rise above 2000 toises; and it was only in ascending and descending through clouds that Mr. Robertson was able to obtain positive electricity.

Artificial Yeast.

The following is the method employed in Germany and Sweden for making artificial yeast. To one hundred pounds of the best malt, consisting of one part of malted wheat

wheat and two parts of malted barley, dried in the open air, and well ground and bruised, add ten pounds of good hops, and brew the mixture with 350 pounds of water, to form wort. After a short boiling separate the grains and hops from the wort; which last, by continued boiling, may be reduced to 175 lbs. Cool it down as soon as possible to 70 degrees of Fahrenheit, and then mix it with 32 lbs. of yeast; the first time may be of common brewers yeast, but in every subsequent operation of the artificial. The wort will soon ferment, and in a few hours it will be covered with a thick yeasty froth; the whole mass must then be strongly agitated, and at the same time well mixed with from 50 to 75 lbs. of fine ground meal, of wheat or barley, malted or unmalted. In a cool place this yeast will keep ten or fifteen days in summer, and four or five weeks in winter. It is said to be as good as the best common yeast for the use of brewers, distillers, bakers, and pastry-cooks *.

Electricity.

Vassali Eandi has shewn, by repeated experiments, that metals and their oxides thrown on his electrometer bring thither a contrary kind of electricity; the metal, positive electricity; and the oxide, negative: and farther, that the electric fluid does not affect the fluid of the voltaic pile; the action of which is not altered by the union of positive electricity, to the negative pile, nor by another combination of electric and Galvanic conductors.

* The specification of a patent, granted to a Mr. Storck, for the same object, was published in the last number of this work.

Phosphate

Phosphate of Soda.

A German apothecary, named Funcke, has discovered a new method of preparing phosphate of soda, which he asserts to be more economical, expeditious, and easy, than any of the processes hitherto used by manufacturers and chemists *. His method consists in saturating the excess of lime contained in calcined bones with dilute sulphuric acid, and then dissolving the remaining posphate of lime in nitric acid. To this solution he adds a like quantity of sulphate of soda, and then recovers the nitric acid by distillation. The phosphate of soda is then separated from the sulphate of lime by the effusion of water and crystallization in the usual manner. A sulphate of soda is produced by mixing into paste, with a sufficient quantity of water, eight parts of burnt gypsum or sulphate of lime, five of clay, and five of common salt. This mixture is burned in a kiln or oven, and then ground to powder; the powder is put into water, which, after being strained and evaporated, is suffered to crystallize.

Potash.

From the experiments of M. Vauquelin, it results that the ashes of buck-wheat are very rich in potash, and may be employed with advantage in the glass-houses. The ashes of other vegetables contain only 18 to 20 *per cent.* of that alkali; those of buck-wheat contain 33, or nearly one-third.

* We apprehend this gentleman is mistaken, and that the method practised in England is more simple and advantageous than the process he describes.

List

List of Patents for Inventions, &c.

(Continued from Page 320.)

LAVER OLIVER, of Bury St. Edmunds, Suffolk, Upholder and Cabinet-maker; for dining, card, Pembroke, and other tables, upon an improved construction. Dated August 3, 1803.

JAMES HALL, of Mellor, in the parish of Glossop, Derbyshire, Weaver; for an improvement to the loom, whereby a new and cheap method of perpetually taking away the articles woven therein as they are woven is effected. Dated August 3, 1803.

FRANCIS GODBOLD, of Craven-street, Westminster, Dice-maker; for new-invented dice. Dated August 3, 1803.

BRYAN DONKIN, of Dartford, Kent, Mill-wright; for a mode of producing a rotatory motion applicable to useful purposes. Dated August 3, 1803.

JOHN EDWARDS, of Vine-street, Lambeth, Surrey, Engineer; for improvements in distilling, rectifying, and dying, whereby the same will be considerably accelerated, and the consumption of fuel will be materially reduced. Dated August 3, 1803.

MICHAEL LOGAN, of Paradise-street, in the parish of St. Mary, Rotherhithe, Surrey, Engineer; for a conservative lock, for the use of inland or canal navigation. Dated August 5, 1803.

CATHCART DEMPSTER, of St. Andrew's, North Britain, Gentleman; for improvements in the manufacture of canvas or strong cloths, of vegetable materials, for sails, tents, packages, and other useful purposes. Dated August 30, 1803.